United States
Department of
Agriculture

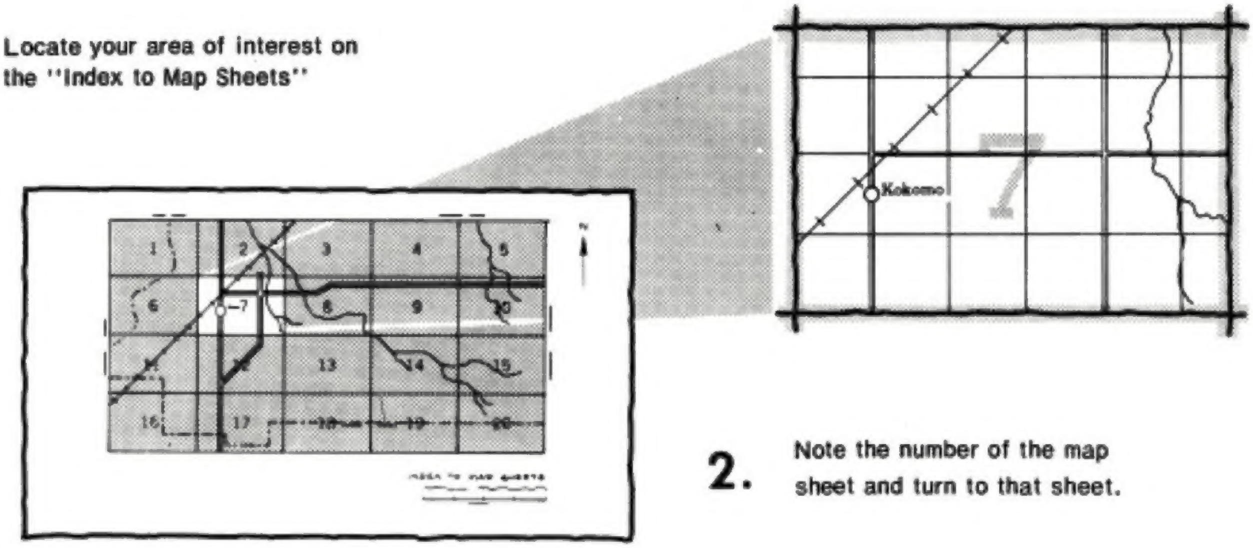
Soil
Conservation
Service

in cooperation with
Iowa Agriculture
and Home Economics
Experiment Station
and the Cooperative
Extension Service
Iowa State University
and Department of
Soil Conservation
State of Iowa

Soil Survey of Clayton County Iowa

HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"



2. Note the number of the map sheet and turn to that sheet.

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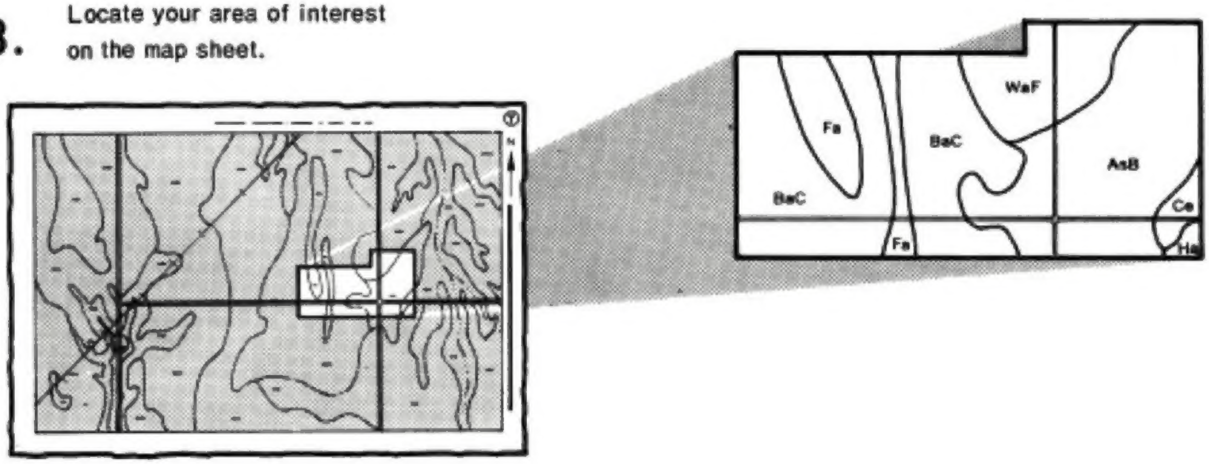
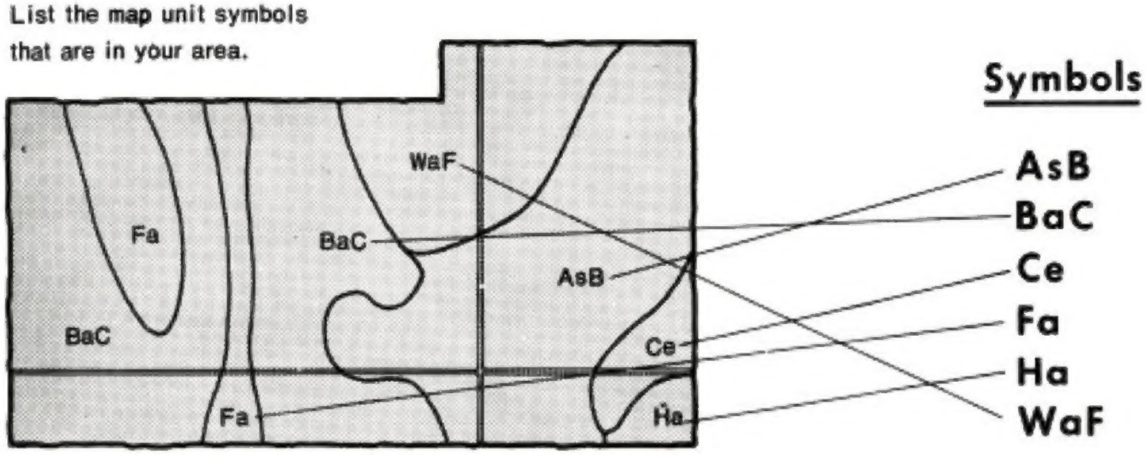
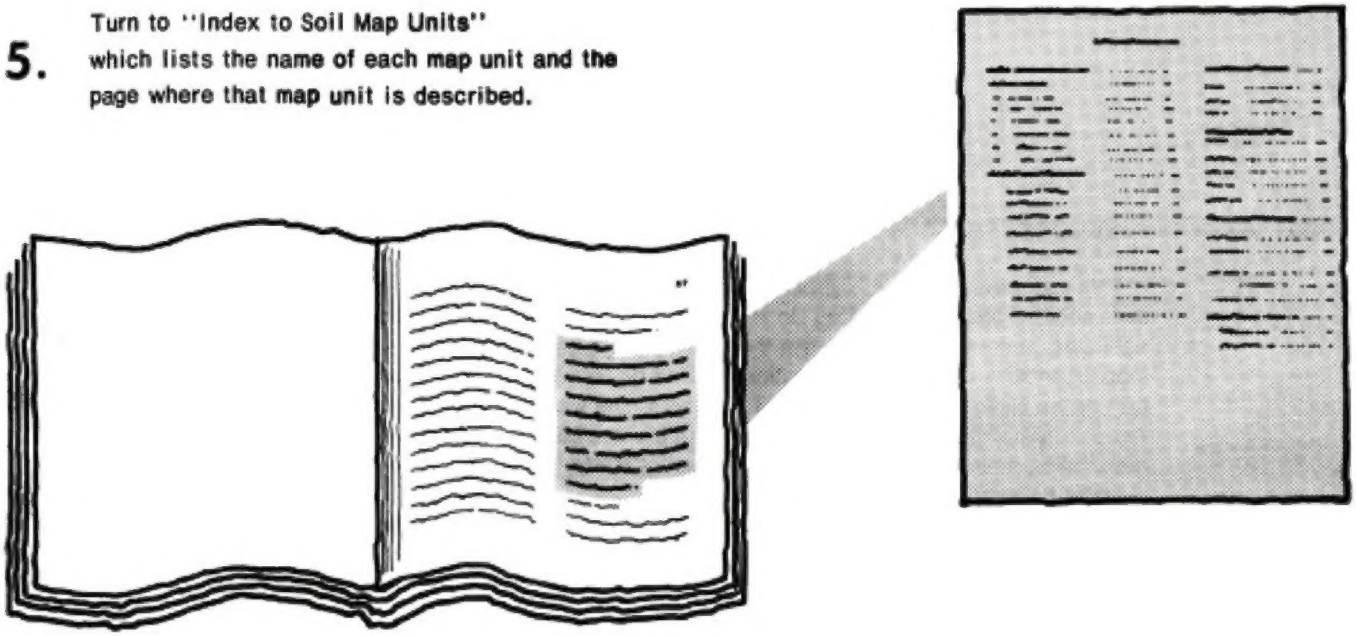


4. List the map unit symbols that are in your area.

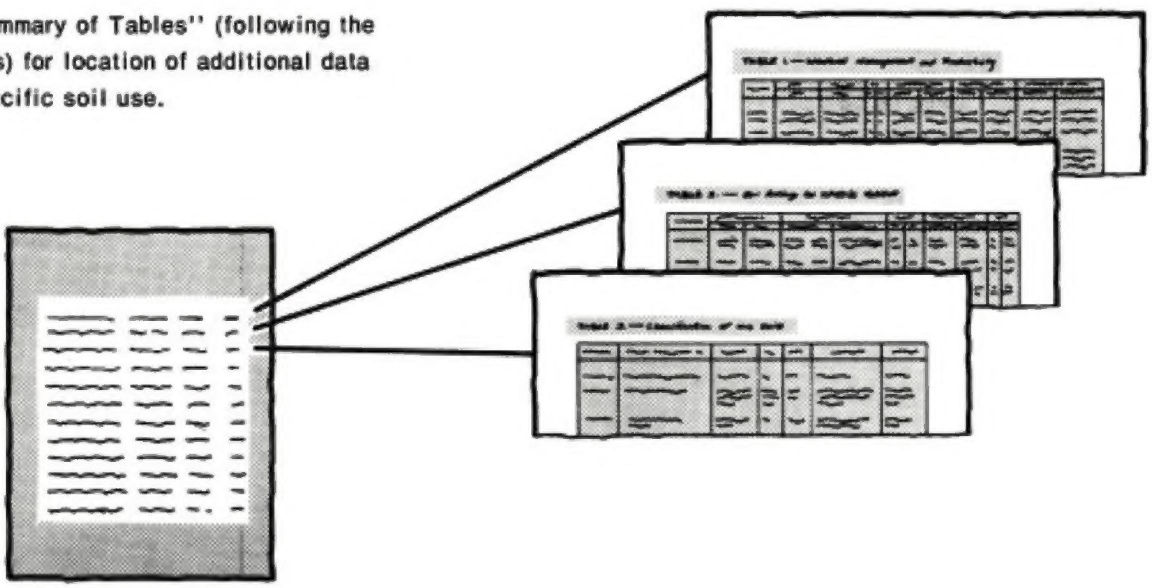


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service; the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Clayton County Soil Conservation District. Funds appropriated by Clayton County were used to defray part of the cost of the survey. Major fieldwork was performed in the period 1973-77. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978.

Cover: Typical area of the Downs-Fayette association. In many areas of this association, the slopes can be terraced and farmed on the contour because they are long and uniform.

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soil series

Issued September 1982

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preface

This soil survey contains information that can be used in land-planning programs in Clayton County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

soil survey of
Clayton County, Iowa

By Ronald J. Kuehl, Soil Conservation Service

Fieldwork by Mary E. Collins, Lyle L. Davis, Ronald J. Kuehl,
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United States Department of Agriculture, Soil Conservation Service,
in cooperation with the Iowa Agriculture and Home Economics Experiment
Station; the Cooperative Extension Service, Iowa State University;
and the Department of Soil Conservation, State of Iowa

CLAYTON COUNTY is in the northeastern part of Iowa (fig. 1). It has an area of 498,752 acres, or 779 square miles. Elkader is the county seat. It is in the center of the county, about 190 miles northeast of Des Moines.

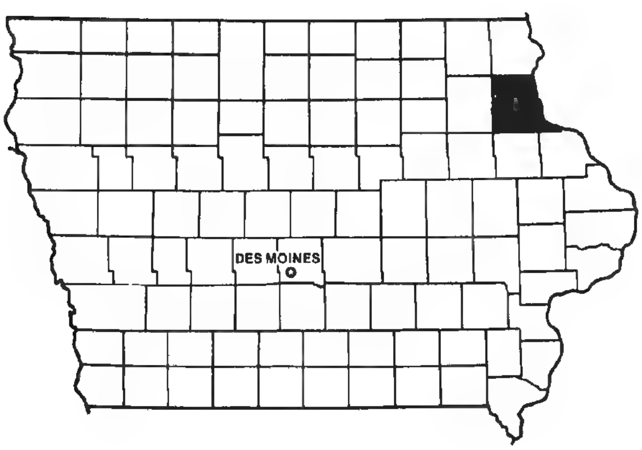

Figure 1.—Location of Clayton County in Iowa.

This survey updates the soil survey of Clayton County published in l925 (*3*). It provides additional information and larger maps, which show the soils in more detail.

general nature of the county

The paragraphs that follow describe the history and development of the county and the transportation facilities, drainage and relief, natural resources, farming, and climate.

history and development

As they travelled down the Mississippi River in 1673, Marquette and Joliet, the French explorers, entered the area now known as Clayton County near the present-day site of the town of Marquette (*9*). The area was under the control of France and Spain until it was acquired by the United States as part of the Louisiana Purchase in 1803. Until about 1830, it was inhabited by many Indian tribes, who were part of three large Indian nations—the Sioux, the Sacs and Foxes, and the Winnebagoes.

Public surveys of the county began in 1836. Almost all of the county was divided into townships and subdivided into sections. The "Giard Grant," a tract of 5,860 acres west of the present-day town of Marquette, however, was not included in the surveys (*9*). On December 21, 1837, prior to the organization of the territory of Iowa, the county boundaries were established by an act approved by the Wisconsin legislature. The county was named after James Clayton, a senator from Delaware.

The county government was organized in the late 1830's. Guttenberg, a German settlement then known as Prairie la Porte, was made the first county seat in 1839.

A series of elections changed the county seat to Garnavillo in 1843; to Elkader, back to Guttenberg, and back to Garnavillo in the 1850's; and finally back to Elkader in 1860.

According to the first census, the population of the county was 274 in 1838. It rapidly increased between 1850 and 1870 and continued to increase until the early 1900's, when it was about 26,000. The growth of the county during this period was in the rural areas. The towns remained small. The county became known as the dairy capital of Iowa. The creameries were almost as numerous as the schools. The population has decreased since the early 1900's. In 1976, it was 21,348. Guttenberg, the largest town, has a population of 2,177, and Elkader, the second largest town, has a population of 1,592.

transportation facilities

U.S. Highway 18, running dominantly east and west, and U.S. Highway 52, running north and south, intersect in the northeastern part of the county. State Highway 13, running north and south, also intersects U.S. Highway 52 in the northeastern part. These routes are connected to all areas of the county by roads surfaced with concrete or crushed rock. All-weather roads pass by most farmsteads.

Mainline railroads are routed through Clayton, Guttenberg, McGregor, and Marquette. Motor freight lines serve every trading center in the county. Small municipal airports are established at Guttenberg and Monona, and a private airport is established at Elkader. Scheduled airline transportation is available at Cedar

Figure 2.—Sinkholes in the drainageways in an area of the Downs-Fayette association near Monona.

Rapids, Dubuque, and Waterloo, all of which are within 70 miles of the county. Bus routes are along the north-south highways. They connect with east-west lines in Manchester, in Delaware County.

drainage and relief

About four-fifths of Clayton County is drained by the southeastward flowing Turkey River and its principal tributary, the Volga River. The Turkey River enters the county about 9 miles south of the northwest corner. It empties into the Mississippi River, which flows southward along the eastern border. The Volga River enters the county about 17 miles south of the northwest corner and runs almost parallel to the Turkey River until it reaches Elkport, where the two streams join.

A small area along the northern border is drained by tributaries of the Yellow River, and a small area in the southwest corner is drained by the Maquoketa River. The water in these streams eventually empties into the Mississippi River.

Scattered sinkholes have a major effect on the drainage throughout the county (fig. 2). They are common in the drainageways in the northern part of the county and on the narrow upland ridges in the southern part. A few are open and are increasing in size. Many others are mantled with soil material and are not enlarging. Some shallow ones are cultivated, but many are deep and cannot be crossed by farm machinery. Each year several new ones form, generally after a period of heavy precipitation. In a few areas, surface water carrying barnyard waste and septic tank effluent drains into the sinkholes and pollutes the underground water supplies (fig. 3).

The highest elevations are about 1,250 feet above sea level. They are in several areas of the county. The lowest elevation is about 600 feet above sea level, in an area near North Buena Vista.

Most of the county is characterized by gently rolling to hilly or steep relief. Typical upland features are high relief, many limestone outcrops, and steep slopes. The topography along the Mississippi River and its tributaries is very steep and rugged. High limestone bluffs or steep rises are between the bottom land and the highest upland ridges. The limestone bluffs rise abruptly to a height of 300 to 400 feet above the river.

The southwest corner of the county is characterized by gently undulating and undulating relief. Typical upland features are plane slopes and low relief. Along the rivers, slopes are steeper and limestone commonly crops out.

natural resources

Clayton County is abundantly supplied with a variety of natural resources other than farmland. Among these resources are limestone, sandstone, sand and gravel, and trees. Lead formerly was an important natural resource. The ore was mined in areas near North Buena Vista and Guttenberg but is no longer a profitable resource.

Limestone is near the surface in many areas throughout the county. It is crushed and used commercially for roadbuilding and concrete and as agricultural lime. Some limestone is used as decorative stone or flagstone.

Sandstone is mined near the town of Clayton. The mine extends several thousand feet back into a bluff along the Mississippi River. Trucks or railroads ship the sandstone to foundries in Iowa. A few sand and gravel pits have been opened on the terraces adjacent to the Turkey and Volga Rivers. The sand and gravel are used extensively as road-surfacing material and concrete aggregate.

The trees in the county are important commercially. A large quantity of walnut and oak logs are cut throughout the year and shipped out of the county. The natural beauty of the trees and limestone bluffs attract many tourists. Several parks have been developed on the scenic heights overlooking the Mississippi River.

farming

Farming is the chief economic enterprise in Clayton County. Most of the local income is derived from the products of dairy cows and the sale of beef cattle and hogs. The county ranks near the top in the state in the number of dairy cows raised and the amount of milk produced.

Dairy cows, beef cattle, and hogs are the most extensively raised livestock in the county. In 1977, about 357,600 hogs, 17,000 grain-fed cattle, and 3,200 grain-fed sheep and lambs were marketed. According to the 1977 Census of Agriculture, the number of 2-year-old milk cows was 29,200, the number of 2-year-old beef cattle was 28,000, and the number of lambs born was 2,480. The number of sows farrowed was 25,900 in the fall of 1976 and 25,700 in the spring of 1977.

The principal crops are corn, oats, hay, and pasture. Corn is the most important cash crop, but the amount sold varies from year to year, depending on the price of feeder cattle, the market for fattened cattle, the market for hogs, the cash price of corn, and the quality of the corn crop. In 1977, corn was grown on 142,600 acres in the county, oats on 39,900 acres, soybeans on 3,600 acres, and hay on 72,300 acres.

The farms in Clayton County, like those throughout the Midwest, have been increasing in size and decreasing in number. They decreased in number from 2,390 in 1967 to 2,040 in 1977 and increased in average size from 168 to 226 acres during this period. In 1977, the average size in the state was 261 acres. In that year, the percentage of owner-operated farms in the county was 59, which is slightly above the state average of 53 percent.

Figure 3.—A sinkhole in an area used for grazing.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Guttenberg, Iowa, in the period 1951 to 1977. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 22 degrees F, and the average daily minimum temperature is 13 degrees. The lowest temperature on record, which occurred at Guttenberg on January 30, 1951, is -36 degrees. In summer the average temperature is 72 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred at Guttenberg on July 27, 1955, is 101 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 32 inches. Of this, 23 inches, or about 70 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 5.7 inches at Guttenberg on July 17, 1966. Thunderstorms occur on about 45 days each year, and most occur in summer. Tornadoes and severe thunderstorms strike occasionally. These storms are local in extent and of short duration and result in only sparse damage in small areas. Hail falls at times during the warmer part of the year in scattered small areas.

Average seasonal snowfall is about 28 inches. The greatest snow depth at any one time during the period of record was 24 inches. On an average of 37 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11 miles per hour, in spring.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

soil descriptions

1. Downs-Fayette association

Gently sloping to moderately steep, well drained soils formed in loess on uplands

This association consists of gently sloping and moderately sloping soils on narrow, convex ridgetops and strongly sloping and moderately steep soils on long, convex side slopes. The side slopes are dissected by many small drainageways. Scattered trees grow in the drainageways and along some fences. Trees also grow in a few small, irregularly shaped wooded areas and in groves around farmsteads. Most of the farmsteads are on ridgetops, but a few are in the small valleys.

This association makes up about 23 percent of the county. It is about 50 percent Downs soils, 35 percent Fayette soils, and 15 percent minor soils (fig. 4).

The Downs soils generally are less sloping than the Fayette soils. Typically, they have a surface layer of very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown silt loam, the next part is dark yellowish brown and yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown and strong brown.

Typically, the Fayette soils have a surface layer of very dark gray silt loam about 2 inches thick. The subsurface layer is grayish brown silt loam about 7 inches thick. The subsoil is about 39 inches thick. It is friable. The upper part is brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with strong brown and grayish brown.

Minor in this association are Huntsville, Lindley, Luana, Mottland, Otter, and Tama soils. The well drained, gently sloping and moderately sloping Tama soils are on ridges and side slopes. Their surface layer is darker than that of either the Downs or Fayette soils. Luana and Mottland soils are on side slopes below the Fayette and Downs soils. The moderately well drained Lindley soils are on nose slopes below the Downs and Fayette soils. The poorly drained Otter and well drained Huntsville soils are on flood plains and low terraces. They have thick, dark upper layers.

This association is used mainly for diversified farming. Corn generally is grown in a rotation with oats and hay (fig. 5), but in some areas it is grown year after year. Much of the grain is fed to beef cattle, dairy cows, and hogs. Dairying is extensive (fig. 6). The farms are about 200 to 240 acres in size.

This association is well suited to poorly suited to row crops. Some areas are too steep for cultivation. The main management needs are measures that control erosion and maintain tilth and fertility. Contour farming, terraces, stripcropping, and a system of conservation tillage that leaves crop residue on the surface help to control erosion. Most areas are well suited to terracing. Tile drainage is needed in some drainageways. In some areas gullies and drainageways should be reshaped and seeded. In places the drainageways limit the size of the fields. Sinkholes are common in the drainageways around Monona. Special care is needed to keep surface water from running through the sinkholes and polluting underground water supplies.

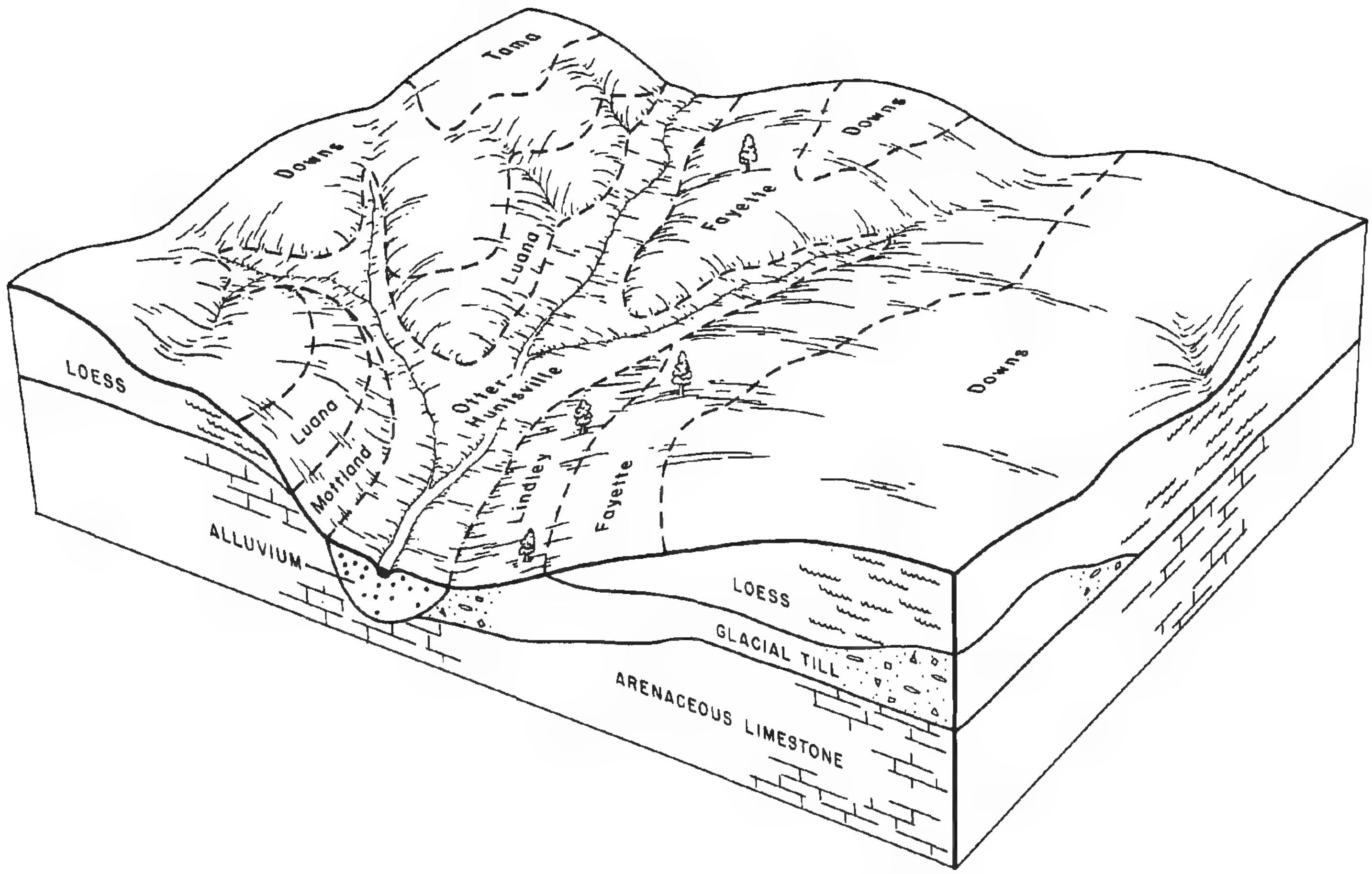

Figure 4.—Typical pattern of soils and parent material in the Downs-Fayette association.

2. Fayette-Exette-Lindley association

Strongly sloping to very steep, well drained and moderately well drained soils formed in loess and glacial till on uplands

This association consists of strongly sloping soils on narrow, convex ridges and moderately steep to very steep soils on short, convex side slopes, nose slopes, and head slopes. The side slopes and head slopes are dissected by many small drainageways and gullies that cannot be crossed by farm machinery. Scattered trees grow in the drainageways and along the fences. Trees also grow in many small, irregularly shaped wooded areas and in groves around farmsteads. Most of the farmsteads are on ridgetops, but many are in small valleys.

This association makes up about 5 percent of the county. It is about 45 percent Fayette soils, 30 percent Exette soils, 20 percent Lindley soils, and 5 percent minor soils (fig. 7).

The well drained, strongly sloping to very steep Fayette soils formed in loess on narrow ridges and short, convex side slopes. The well drained, strongly sloping to steep Exette soils formed in loess on convex head slopes and side slopes near the upper end of upland drainageways. The moderately well drained, strongly sloping to steep Lindley soils formed in glacial till on convex nose slopes below the Fayette and Exette soils.

Typically, the Fayette soils have a surface layer of very dark gray silt loam about 2 inches thick. The subsurface layer is grayish brown silt loam about 7 inches thick. The subsoil is about 39 inches thick. It is friable. The upper part is brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with strong brown and grayish brown.

Typically, the Exette soils have a surface layer of brown silt loam about 6 inches thick. The subsoil is friable silt loam about 32 inches thick. The upper part is

Figure 5.—Typical cropping pattern in a gently sloping and moderately sloping area of the Downs-Fayette association.

Figure 6.—Dairy herd on rotation pasture in an area of the Downs-Fayette association.

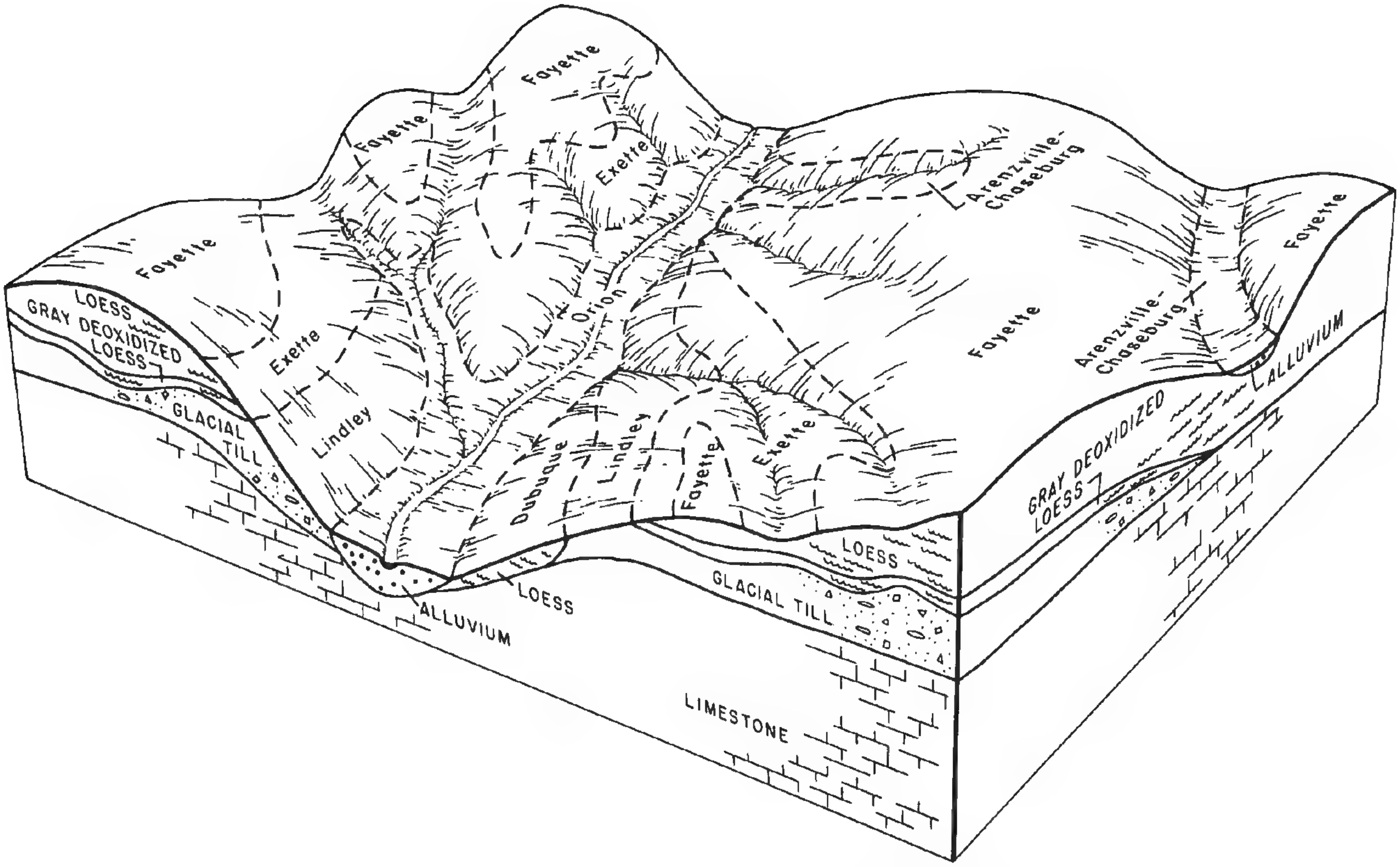

Figure 7.—Typical pattern of soils and parent material in the Fayette-Exette-Lindley association.

brown, the next part is yellowish brown and has strong brown and grayish brown mottles, and the lower part is grayish brown and has yellowish brown and light olive brown mottles. The substratum to a depth of about 60 inches is light brownish gray silt loam that has large accumulations of yellowish red iron.

Typically, the Lindley soils have a surface layer of dark grayish brown and brown loam about 6 inches thick. The subsoil is about 31 inches thick. The upper part is yellowish brown, friable loam; the next part is yellowish brown, friable clay loam; and the lower part is yellowish brown, firm clay loam mottled with gray. The substratum to a depth of about 60 inches is strong brown clay loam mottled with gray.

Minor in this association are Arenzville, Chaseburg, Dubuque, and Orion soils. The moderately deep Dubuque soils are on side slopes and nose slopes below the major soils. The well drained or moderately well drained Arenzville and Chaseburg and somewhat poorly drained Orion soils are in narrow upland drainageways and on foot slopes. They are less sloping than the major soils and are lower on the landscape. They formed in silty alluvium.

This association is used mainly for hay and pasture. In many areas it is best suited to those uses. Raising dairy cows or beef cattle is the major farm enterprise. In some areas corn is grown in rotation with oats and hay. Much of the grain is fed to dairy cows and beef cattle. Some is fed to hogs and sheep.

This association is moderately well suited or poorly suited to cultivated crops. Some areas are too steep for cultivation. The main management needs are measures that control erosion and maintain tilth and fertility. Most areas are not suitable for terracing because the slopes are too steep and are short and complex. Returning crop residue to the soil or regularly adding other organic material helps to control erosion, improves fertility, and increases the rate of water infiltration. Tile drains are needed in some drainageways. In some areas gullies and drainageways should be reshaped and seeded.

3. Fayette-Nordness-Rock outcrop association

Rock outcrop and moderately sloping to very steep, well drained soils formed in loess or in loamy surficial sediments and the underlying residuum of limestone; on uplands

This association mainly consists of moderately sloping and strongly sloping soils on convex ridgetops and strongly sloping to very steep soils on convex side slopes. The landscape is characterized by narrow, meandering valleys bordered by very steep, irregular side slopes where limestone bedrock crops out (fig. 8). The limestone forms steep bluffs that rise abruptly 100 to 200 feet above the surrounding area. The bluffs along the Mississippi River rise nearly 400 feet above the river. Some of the bluffs are between bottom land and the highest upland ridges.

This association makes up about 62 percent of the county. It is about 50 percent Fayette soils, 18 percent Nordness soils, 17 percent Rock outcrop, and 15 percent minor soils.

The Fayette soils formed in loess. They are moderately sloping and strongly sloping on ridgetops and strongly sloping to very steep on side slopes. The shallow, strongly sloping to steep Nordness soils are on convex side slopes below the Fayette soils. They formed

Figure 8.—A scenic area of the Fayette-Nordness-Rock outcrop association near the Mississippi River.

in loamy or silty sediments and in the underlying residuum of limestone.

Typically, the Fayette soils have a surface layer of very dark gray silt loam about 2 inches thick. The subsurface layer is grayish brown silt loam about 7 inches thick. The subsoil is about 39 inches thick. It is friable. The upper part is brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with strong brown and grayish brown.

Typically, the Nordness soils have a surface layer of very dark grayish brown silt loam about 2 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is about 10 inches thick. The upper part is brown, friable silt loam, and the lower part is dark brown, very firm clay. Limestone bedrock is at a depth of about 16 inches.

The Rock outcrop is exposed limestone bedrock on very steep upland slopes and escarpments. In some areas a thin layer of silt loam or loam overlies the bedrock. In other areas limestone fragments cover much of the surface.

Minor in this association are Dorchester, Dubuque, and Volney soils. The moderately deep Dubuque soils are on nose slopes and side slopes below the Fayette soils. They make up about 8 percent of the association. The moderately well drained Dorchester soils are in upland drainageways. The somewhat excessively drained Volney soils are on alluvial fans and the lower parts of narrow upland drainageways.

This association is used mainly for hay, pasture, or trees. Raising dairy cows, beef cattle, or hogs is the major farm enterprise. In the less sloping areas, corn is grown in rotation with oats and hay. Most of the grain is fed to the livestock. The farms average about 200 acres in size. Most of the farmsteads are on ridgetops, but a few are in small valleys.

The moderately steep to very steep soils are poorly suited or unsuited to cultivated crops because of the slope and the shallowness to limestone bedrock. The moderately sloping and strongly sloping soils are moderately well suited to row crops. The main management needs are measures that control erosion and maintain tilth and fertility. Contour farming, terraces, stripcropping, and a conservation tillage system that leaves crop residue on the surface help to control erosion.

This is a scenic association. Only a few winding roads cross the valleys, and limestone bedrock crops out in many of the road cuts. Woodland and pasture border the bluffs in most of the uplands. Scattered trees grow in the drainageways and along fences. Trees also grow in many irregularly shaped timbered areas and in patches of the native oak-hickory forest. Some of the timbered areas range from 40 to 800 acres in size.

4. Dorchester-Bertrand-Wapsie association

Nearly level to gently sloping, moderately well drained and well drained soils formed in silty, loamy, and sandy alluvial sediments on bottom land and stream benches

This association consists of nearly level and gently sloping soils on bottom land and stream benches along the Turkey, Volga, and Mississippi Rivers and their tributaries and moderately steep soils in a few areas on terrace escarpments. The soils on bottom land are subject to flooding. In some areas those on the stream benches receive runoff from the adjacent hillsides.

This association makes up about 5 percent of the county. It is about 35 percent Dorchester soils, 25 percent Bertrand soils, 20 percent Wapsie soils, and 20 percent minor soils (fig. 9).

The moderately well drained Dorchester soils are on bottom land and are subject to flooding. The well drained Bertrand and Wapsie soils are on stream benches.

Typically, the Dorchester soils have a surface layer of dark grayish brown silt loam about 8 inches thick. The substratum is dark grayish brown, grayish brown, and brown, stratified silt loam about 23 inches thick. Below this to a depth of about 60 inches is a buried surface layer of black and very dark brown silt loam.

Typically, the Bertrand soils have a surface layer of dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown and yellowish brown silt loam about 9 inches thick. The subsoil is yellowish brown, friable silt loam about 35 inches thick. The substratum to a depth of about 60 inches is yellowish brown, stratified silt loam and loamy sand.

Typically, the Wapsie soils have a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is about 30 inches thick. The upper part is brown, friable loam; the next part is yellowish brown, friable loam; and the lower part is brown, very friable sandy loam and gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly sand.

Minor in this association are Caneek, Richwood, Rowley, Saude, and Spillville soils. The well drained Saude and Richwood soils are on stream benches. The somewhat poorly drained Rowley soils are at the slightly lower elevations on stream benches. The moderately well drained Spillville soils are at the slightly higher elevations on bottom land. They have thick, dark upper layers. The somewhat poorly drained and poorly drained Caneek soils are on bottom land near streams.

Corn is grown year after year on most of the bottom land. It generally is grown in rotation with oats and hay on the stream benches. Much of the grain is fed to beef cattle, dairy cows, and hogs. The number of farms is fewer than on other associations, and the size ranges from 200 to 280 acres. Most of the farmsteads are on the stream benches, but a few are on bottom land.

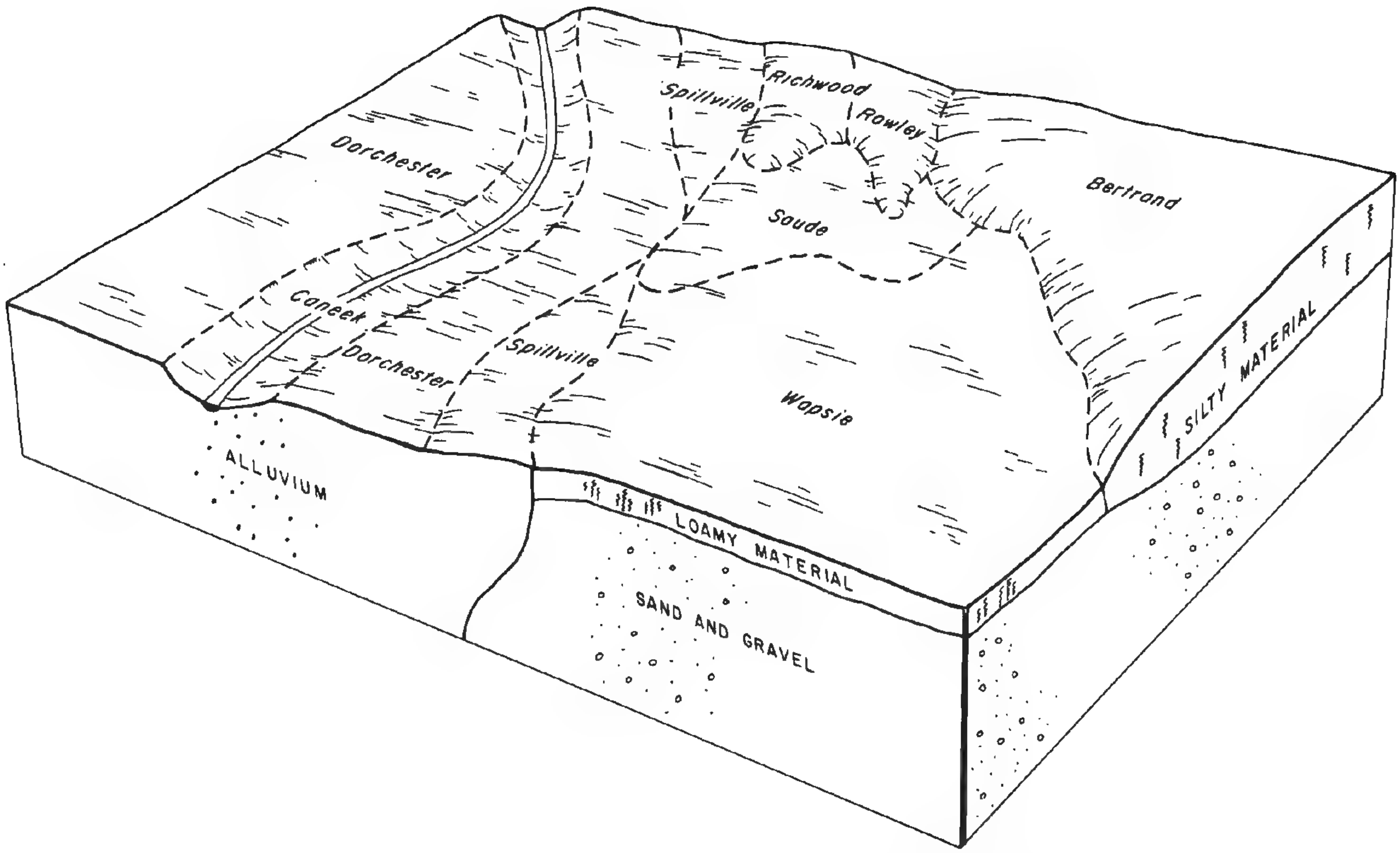

Figure 9.—Typical pattern of soils and parent material in the Dorchester-Bertrand-Wapsie association.

This association is well suited to poorly suited to cultivated crops. The main management needs are measures that control flooding on the bottom land and maintain tilth and fertility on the benches. The flooding generally occurs during thaws early in the spring or after heavy rains, prior to the growing season. The Wapsie and Saude soils generally are droughty in years of average or below average rainfall because they are 24 to 32 inches deep over sand and gravel.

This is a scenic association. Only a few winding roads cross the valleys. The farms and roads commonly form irregular patterns. The shape of the fields is determined by the boundaries of streams, old stream meanders, and oxbows. Some of the roads are parallel to the rivers, but only a few cross them.

5. Kenyon-Clyde-Floyd association

Nearly level to gently sloping, moderately well drained to poorly drained soils formed in loamy surficial sediments and the underlying glacial till on uplands

This association is characterized by long, gentle slopes, slightly rounded knolls, and many low gradient drainageways. Rounded granite stones and boulders formerly were common on the surface but were removed before the soils were cultivated. The soils formed in loamy material and glacial till that are separated from each other by a stone line (fig. 10).

This association makes up about 3 percent of the county. It is about 41 percent Kenyon soils, 29 percent Clyde soils, 20 percent Floyd soils, and 10 percent minor soils (fig. 11).

The moderately well drained, gently sloping Kenyon soils are on summits and long, smooth, convex side slopes above the Clyde and Floyd soils. The poorly drained, nearly level to gently sloping Clyde soils are in drainageways. The somewhat poorly drained, nearly level to gently sloping Floyd soils generally are on foot slopes at intermediate elevations between the Kenyon and Clyde soils.

In a typical area of the Kenyon soils, the surface soil is very dark brown loam about 11 inches thick. The subsoil is loam about 39 inches thick. The upper part is brown and friable, the next part is yellowish brown and friable, and the lower part is mottled grayish brown and yellowish brown and is firm. The substratum to a depth

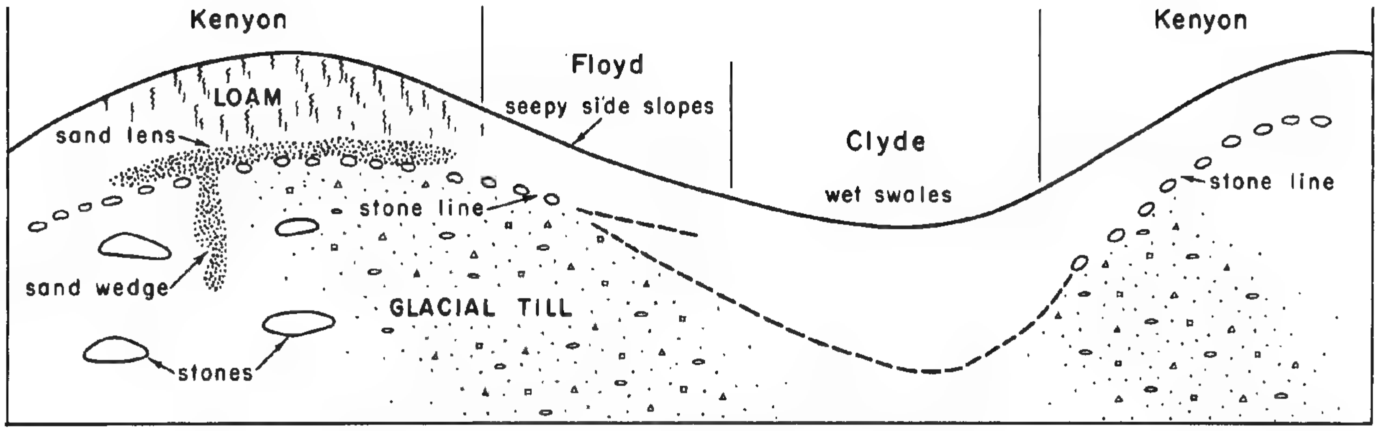

Figure 10.—The parent material of Kenyon, Floyd, and Clyde soils.

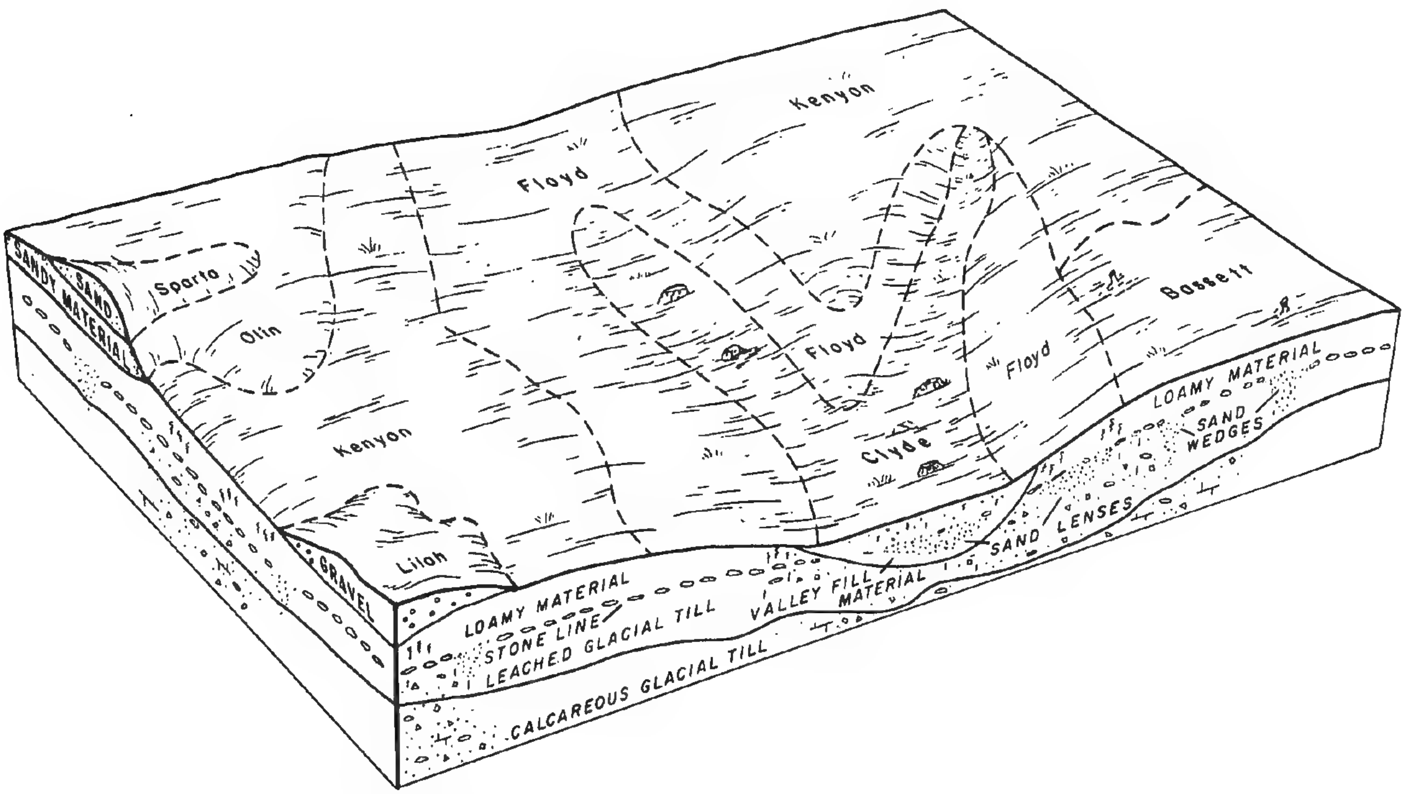

Figure 11.—Typical pattern of soils and parent material in the Kenyon-Clyde-Floyd association.

of about 60 inches is mottled yellowish brown and grayish brown loam.

Typically, the Clyde soils have a surface layer of black clay loam about 9 inches thick. The subsurface layer is about 14 inches of black clay loam and very dark gray silty clay loam. The subsoil is about 20 inches thick. The upper part is mottled gray and light olive brown, friable silty clay loam; the next part is mottled gray and strong brown, friable sandy loam; and the lower part is mottled grayish brown and yellowish brown, firm loam. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown loam.

Typically, the Floyd soils have a surface layer of black loam about 7 inches thick. The subsurface layer is black

loam about 8 inches thick. The subsoil is about 34 inches thick. The upper part is mottled dark grayish brown, grayish brown, and yellowish brown, friable loam; the next part is mottled grayish brown and strong brown, very friable sandy loam and loamy sand; and the lower part is strong brown, firm loam. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown loam.

Minor in this association are Bassett, Lilah, Olin, and Sparta soils. The moderately well drained, gently sloping and moderately sloping Bassett soils are on summits and convex side slopes. The excessively drained Lilah and Sparta soils are in outwash areas above the Kenyon and Bassett soils. The gently sloping and moderately sloping, well drained Olin soils formed in moderately coarse textured sediments and the underlying glacial till. They are on ridges and side slopes.

Farming is less diversified on this association than on the other associations. The soils are used mainly for cultivated crops. Corn and soybeans are the major crops (fig. 12). Dairy cows are raised in some areas, but only small areas are used for hay and pasture. The farms are about 160 to 240 acres in size.

This association generally is well suited to intensive row cropping. The main management needs are measures that improve drainage, control erosion, and maintain tilth and fertility. Water moves more rapidly through the loamy surficial sediments than through the firm loam glacial till. It accumulates along the contact between the two kinds of material and moves downslope along this contact until it emerges in a seepy area on a side slope or saturates the upper layers of soils on foot slopes or toe slopes. Although contour farming and terraces help to control erosion, they tend to aggravate the drainage problem. As a result, a combination of terraces and drainage tile generally is needed to reduce

Figure 12.—Corn in a typical area of the Kenyon-Clyde-Floyd association.

the wetness and the susceptibility to erosion. Installing interceptor tile upslope from wet spots helps to prevent excessive wetness.

6. Bassett-Backbone-Winneshiek association

Gently sloping to strongly sloping, moderately well drained to somewhat excessively drained soils formed in loamy surficial sediments, glacial till, and residuum of limestone on uplands

This association consists of gently sloping soils on narrow ridgetops and moderately sloping and strongly sloping soils on convex side slopes. Limestone bedrock is near the surface of the side slopes and crops out in some areas. Along the Maquoketa River, the slopes break sharply and limestone escarpments are numerous. Many small, irregularly shaped areas are timbered. Trees also grow along fences and in groves around farmsteads.

This association makes up about 2 percent of the county. It is about 35 percent Bassett soils, 25 percent Backbone soils, 20 percent Winneshiek soils, and 20 percent minor soils.

The moderately well drained, gently sloping and moderately sloping Bassett soils are on the higher ridges and side slopes. The somewhat excessively drained Backbone and well drained Winneshiek soils are on convex ridges and side slopes below the Bassett soils. The Backbone soils are gently sloping to strongly sloping, and the Winneshiek soils are gently sloping and moderately sloping.

Typically, the Bassett soils have a surface layer of very dark grayish brown loam about 8 inches thick. The subsurface layer is brown loam about 6 inches thick. The subsoil is about 39 inches thick. The upper part is yellowish brown, friable loam; the next part is yellowish brown, firm loam mottled with grayish brown and brown; and the lower part is mottled yellowish brown and grayish brown, firm loam. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown, firm loam.

Typically, the Backbone soils have a surface layer of very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 19 inches thick. The upper part is brown, very friable fine sandy loam; the next part is brown and dark yellowish brown, friable fine sandy loam and sandy loam; and the lower part is strong brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 27 inches.

Typically, the Winneshiek soils have a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is about 19 inches thick. The upper part is brown, friable loam; the next part is dark yellowish brown, friable clay loam; and the lower part is yellowish brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 27 inches.

Minor in this association are Chelsea, Lamont, Nordness, and Rockton soils. The excessively drained, coarse textured Chelsea soils and the well drained, moderately coarse textured Lamont soils are on ridges and side slopes above the Backbone and Winneshiek soils. The well drained, shallow Nordness soils are on side slopes below the Backbone and Winneshiek soils. The well drained, moderately deep Rockton soils are on ridges and side slopes below the Bassett soils.

This association is used mainly for diversified farming. Corn generally is grown in rotation with oats and hay. Much of the grain is fed to dairy cows, beef cattle, and hogs. The farms are about 120 to 180 acres in size.

This association is well suited to poorly suited to cultivated crops. In some areas the soils are too shallow or too steep for cultivation. These areas generally are wooded or are used for permanent pasture. The main management concerns are erosion, the level of fertility, and the limited soil depth, which restricts the root zone. Most areas are not suitable for terracing. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Returning crop residue to the soil or regularly adding other organic material increases the rate of water infiltration, improves fertility, and reduces the runoff rate.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and identifies the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Fayette silt loam, 5 to 9 percent slopes, is one of several phases in the Fayette series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Clyde-Floyd complex, 1 to 4 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimilar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, limestone quarries, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

40—Fayette silt loam, karst, 9 to 25 percent slopes. This strongly sloping to steep, well drained soil is on convex side slopes adjoining upland drainageways. Areas are circular and range from 2 to 15 acres in size.

Large sinkholes or caverns characterize the landscape (fig. 13). They are 15 to 50 feet deep and 30 to 100 feet wide. They result from the dissolving of soluble limestone and dolomite rocks, which are exposed in the drainageways. The limestone is highly fractured with large crevices that are many feet deep. Many of the sinkholes have nearly vertical walls and expose the underground limestone crevices and caverns. Some of the large sinkholes formed when the roof over the cavern collapsed. The limestone bedrock underlies this soil at a depth of about 5 to 8 feet.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark gray and dark grayish brown silt loam about 4 inches thick. The subsoil is about 33 inches thick. The upper part is brown, friable silty clay loam; the next part is yellowish brown, friable silty clay loam; and the lower part is yellowish brown, friable silt loam. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is rapid in cultivated areas. Near the sinkholes, however, water moves into the underlying fractured limestone bedrock at a very rapid rate. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The content of organic matter is 1 to 2 percent in the surface layer.

Figure 13.—An area of Fayette silt loam, karst, 9 to 25 percent slopes.

Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most of the areas surrounding the sinkholes support trees. The trees grow well, but harvesting them could be hazardous.

This soil generally is unsuitable for cultivation or for hay and pasture. Operating farm machinery around the sinkholes is difficult and dangerous. The sinkholes also are hazardous to grazing livestock. Animal waste can pollute ground water supplies.

The capability subclass is VIIe.

41B—Sparta loamy fine sand, 2 to 5 percent slopes. This gently sloping, excessively drained soil is on convex upland slopes and on a few stream benches. Areas are irregularly shaped and generally are 5 to 10 acres in size.

Typically, the surface layer is very dark brown loamy fine sand about 8 inches thick. The subsurface layer is very dark brown and dark brown loamy fine sand about 15 inches thick. The subsoil is brown, very friable loamy fine sand about 6 inches thick. The substratum to a

depth of about 60 inches is yellowish brown and light yellowish brown, loose sand and fine sand. In some areas the surface layer is very dark brown and dark brown, friable fine sandy loam. In other areas the surface soil is less than 10 inches thick.

Permeability is rapid. Available water capacity is low. Surface runoff is slow. Tilth is poor because the content of organic matter is only 1 to 2 percent in the surface layer and because the soil structure breaks down easily. Reaction typically is slightly acid or medium acid in the surface soil and medium acid or strongly acid in the subsoil. It varies in the surface layer, however, because of local liming practices. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are used for cultivated crops or for pasture. This soil is poorly suited to corn, small grain, and soybeans, mainly because it is droughty and low in fertility. Plants respond poorly to applications of fertilizer. Soil blowing and water erosion are hazards if cultivated crops are grown. Blowing sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. The soil is poorly suited to terracing.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in good condition.

Only a few areas are used as woodland. This soil is moderately well suited to trees. Seedling mortality is severe. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Supplemental water may be needed because the soil is droughty. Competing vegetation can be controlled by careful site preparation or by spraying, cutting, or girdling.

The capability subclass is IVs.

41C—Sparta loamy fine sand, 5 to 12 percent slopes. This moderately sloping and strongly sloping, excessively drained soil is on convex slopes in the uplands. Areas are irregularly shaped and generally are 5 to 10 acres in size.

Typically, the surface layer is very dark brown loamy fine sand about 8 inches thick. The subsurface layer is very dark brown loamy fine sand about 5 inches thick. The subsoil is dark brown and brown, very friable loamy fine sand about 14 inches thick. The substratum to a depth of about 60 inches is yellowish brown, loose sand and fine sand. In some areas the surface layer is dark brown and very dark brown, friable fine sandy loam. In other areas the surface soil is less than 10 inches thick.

Permeability is rapid. Available water capacity is low. Surface runoff is medium. Tilth is poor because the content of organic matter is only 1 to 2 percent in the surface layer and because the soil structure breaks down easily. Reaction typically is slightly acid or medium acid in the surface soil and medium acid or strongly acid in the subsoil. It varies in the surface layer, however, because of local liming practices. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are used for cultivated crops or for pasture. This soil generally is unsuitable for cultivation, however, mainly because it is droughty, low in fertility, and highly susceptible to water erosion. Also, soil blowing is a hazard. Blowing sand grains can damage seedlings on this soil and on the adjacent soils.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in good condition.

Only a few areas are used as woodland. This soil is moderately well suited to trees. Seedling mortality is severe. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. Measures that control erosion are needed until the trees are large enough to provide a protective cover.

The capability subclass is VIs.

63B—Chelsea loamy fine sand, 2 to 5 percent slopes. This gently sloping, excessively drained soil is on convex slopes in the uplands and on a few stream terraces. Areas are irregularly shaped and generally are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 5 inches thick. The subsurface layer is about 36 inches of dark grayish brown, brown, and yellowish brown loamy fine sand and sand. The subsoil is about 22 inches thick. It is yellowish brown, loose fine sand that has many bands of dark brown sandy loam. In some areas the surface layer is dark brown fine sandy loam.

Permeability is rapid. Available water capacity is low. Surface runoff is medium. Tilth is poor because the content of organic matter is only 0.5 to 1.0 percent in the surface layer and because the soil structure breaks down easily. Reaction typically is neutral or slightly acid in the surface layer and ranges from strongly acid to neutral in the subsurface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are used for permanent pasture. This soil is poorly suited to corn, soybeans, small grain, hay, and pasture, mainly because it is droughty and low in fertility. Also, water erosion and soil blowing are hazards if cultivated crops are grown. Blowing sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves crop residue

on the surface helps to prevent excessive soil loss. The soil is poorly suited to terracing. A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in fairly good condition.

A few areas support native hardwoods. This soil is moderately well suited to trees. Seedling mortality is moderate. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVs.

63C—Chelsea loamy fine sand, 5 to 14 percent slopes. This moderately sloping and strongly sloping, excessively drained soil is on convex slopes in the uplands. Areas are irregularly shaped and are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 4 inches thick. The subsurface layer is about 36 inches of dark grayish brown, brown, and yellowish brown, loose loamy fine sand and fine sand. The subsoil is about 20 inches thick. It is yellowish brown, loose fine sand that has many bands of dark brown sandy loam. In some areas the surface layer is dark brown fine sandy loam.

Permeability is rapid. Available water capacity is low. Surface runoff is rapid. Tilth is poor because the content of organic matter is only 0.5 to 1.0 percent in the surface layer and because the soil structure breaks down easily. Reaction ranges from medium acid to neutral in the surface layer and from strongly acid to neutral in the subsurface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture. This soil generally is unsuitable for cultivated crops, mainly because it is droughty, low in fertility, and highly susceptible to water erosion. Also, soil blowing is a hazard. Blowing sand grains can damage seedlings on this soil and on the adjacent soils. A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in fairly good condition.

A few areas support native hardwoods. This soil is moderately well suited to trees. The pastured areas can be converted to woodland. Seedling mortality is moderate. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by careful site preparation or by spraying or cutting.

The capability subclass is VIs.

63E—Chelsea loamy fine sand, 14 to 25 percent slopes. This moderately steep and steep, excessively drained soil is on convex slopes in the uplands and on escarpments of stream benches. Areas are irregularly shaped and generally are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 3 inches thick. The subsurface layer is about 30 inches of dark grayish brown, brown, and yellowish brown loamy fine sand and fine sand. The subsoil is about 27 inches thick. It is yellowish brown, loose fine sand that has many bands of dark brown sandy loam. In some areas the surface layer is brown loamy fine sand.

Included with this soil in mapping are small areas of soils that are underlain by coarse sand and gravel. These soils are on escarpments. They make up less than 5 percent of the unit.

Permeability is rapid. Available water capacity is low. Surface runoff is rapid. Tilth is poor because the content of organic matter is only 0.5 to 1.0 percent in the surface layer and because the soil structure breaks down easily. Reaction ranges from medium acid to neutral in the surface layer and from strongly acid to neutral in the subsurface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas support native hardwoods. A few are pastured. This soil is not suited to cultivated crops and is poorly suited to hay and pasture, mainly because it is droughty, low in fertility, and moderately steep and steep. Also, it is subject to soil blowing. As a result, a permanent plant cover is needed. A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in fairly good condition. Renovating pastures is difficult because slopes are too steep for the use of ordinary farm machinery.

This soil is moderately well suited to trees. The pastured areas can be converted to woodland. The equipment limitation is severe, and seedling mortality and the hazard of erosion are moderate. Seedlings should be planted at close intervals because the survival rate is limited. Thinning the stand helps to provide adequate growing space for the surviving trees. Measures that control erosion are needed until the trees are large enough to provide a protective cover. Competing vegetation can be controlled by careful site preparation or by spraying or cutting.

The capability subclass is VIIs.

65D2—Lindley loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex nose slopes and side slopes in the uplands. Areas are irregularly shaped and are 5 to 10 acres in size.

Typically, the surface layer is mixed dark grayish brown and brown loam about 6 inches thick. The subsoil

is about 28 inches thick. It is yellowish brown. The upper part is friable loam, the next part is friable clay loam, and the lower part is firm clay loam mottled with grayish brown and gray. The substratum to a depth of about 60 inches is strong brown, firm clay loam mottled with gray. In some areas the surface layer is brown and yellowish brown loam.

Permeability is moderately slow. Available water capacity is moderate or high. Surface runoff is rapid. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The content of organic matter is less than 0.5 percent in the surface layer. This layer typically is medium acid or strongly acid. The subsoil is strongly acid or very strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are used for permanent pasture or cultivated crops. This soil is poorly suited to corn and soybeans. If cultivated crops are grown, erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. Growing the row crops in rotation with oats, hay, and pasture also is helpful. The soil is not suitable for terracing. It is low in fertility and has a highly dense subsoil. Revegetating is difficult if the subsoil is exposed. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

A few areas are wooded. This soil is moderately well suited to trees. Laying out logging trails or roads on the contour or nearly on the contour helps to control erosion. Seedling mortality and plant competition are slight.

The capability subclass is IVe.

65F2—Lindley loam, 14 to 25 percent slopes, moderately eroded. This moderately steep and steep, moderately well drained soil is on short, convex side slopes and nose slopes in the uplands. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is mixed dark grayish brown and brown loam about 6 inches thick. The subsoil is about 31 inches thick. It is yellowish brown. The upper part is friable loam, the next part is friable clay loam, and the lower part is firm clay loam mottled with grayish brown, strong brown, and gray. The substratum to a depth of about 60 inches is strong brown, firm clay loam mottled with gray. In some areas the surface layer is brown and yellowish brown loam.

Included with this soil in mapping are small areas of red clay or sand on the higher parts of the side slopes. Water seeps from these areas during extended wet periods. Included areas make up 2 to 6 percent of the unit.

Permeability is moderately slow. Available water capacity is moderate or high. Surface runoff is rapid. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is less than 0.5 percent in the surface layer. Unless limed, this layer typically is medium acid or strongly acid. The subsoil also is medium acid or strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Although formerly cultivated, most areas are used for permanent pasture. This soil generally is not suited to cultivated crops because further erosion is a severe hazard and in some areas slopes are too steep for the use of ordinary farm machinery. A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

A few areas are wooded. This soil is moderately well suited to trees. Seedling mortality, the equipment limitation, and the hazard of erosion are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment. Seedlings should be planted at close intervals because the survival rate is limited. Thinning the stand helps to provide adequate growing space for the surviving trees.

The capability subclass is VIe.

65F3—Lindley loam, 14 to 25 percent slopes, severely eroded. This moderately steep and steep, moderately well drained soil is on short, convex side slopes and nose slopes in the uplands. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is brown loam about 6 inches thick. The subsoil is about 24 inches thick. It is yellowish brown. The upper part is friable loam, the next part is friable clay loam, and the lower part is firm clay loam mottled with grayish brown and gray. The substratum to a depth of about 60 inches is strong brown, firm clay loam mottled with gray.

Included with this soil in mapping are small areas of red clay or sand on the higher parts of the side slopes. Water seeps from these areas during extended wet

periods. Included areas make up 2 to 5 percent of the unit.

Permeability is moderately slow. Available water capacity is moderate or high. Surface runoff is very rapid. Tilth is poor. If cultivated, the soil tends to puddle and crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is less than 0.5 percent in the surface layer. This layer typically is strongly acid if it has been limed within the last 5 years. The subsoil typically is strongly acid or very strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Although formerly cultivated, most areas are used for permanent pasture. This soil is not suited to row crops because further erosion is a severe hazard and in some areas slopes are too steep for the use of ordinary farm machinery. A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition. Regularly adding organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A few areas are wooded. This soil is moderately well suited to trees. Seedling mortality, the equipment limitation, and the hazard of erosion are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment. Seedlings should be planted at close intervals because the survival rate is limited. Thinning the stand helps to provide adequate growing space for the surviving trees.

The capability subclass is VIIe.

83B—Kenyon loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridges and side slopes in the uplands. Areas are 20 to 75 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark brown loam about 4 inches thick. The subsoil is loam about 39 inches thick. The upper part is brown and friable, the next part is yellowish brown and friable, and the lower part is mixed grayish brown and yellowish brown, is mottled with strong brown, and is firm. The substratum to a depth of about 60 inches is mixed yellowish brown and grayish brown loam mottled with strong brown. It is mildly alkaline and calcareous.

Included with this soil in mapping are scattered small areas of soils that have a sandy surface layer. These soils make up less than 5 percent of the unit. Also included are a few eroded areas on convex side slopes. These areas make up 2 to 5 percent of the unit.

Permeability is moderate. Available water capacity is high. Surface runoff is medium in cultivated areas. Tilth is good. The content of organic matter is about 3 to 4 percent in the surface layer. Reaction typically is slightly acid in the surface soil and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated, however, it is subject to erosion. Also, wetness is a limitation. Measures that control erosion tend to increase the wetness because they retard the movement of surface water. More of the water soaks into the soil. As a result, the water table is temporarily high and hillside seepage occurs in some areas. A combination of terraces and tile drainage is probably the best method of reducing both the susceptibility to erosion and the wetness. If terraces are built, cuts should not expose the less productive glacial till subsoil.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

84—Clyde clay loam, 1 to 3 percent slopes. This very gently sloping, poorly drained soil is in upland drainageways. Areas commonly are long and narrow and are 20 acres or more in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is about 14 inches of black and very dark gray clay loam and silty clay loam. The subsoil is about 20 inches thick. The upper part is mottled gray and light olive brown, friable silty clay loam; the next part is mottled gray and strong brown, friable sandy loam; and the lower part is mottled yellowish brown and grayish brown, firm loam. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown loam that is mildly alkaline and calcareous.

Included with this soil in mapping are small areas of muck in depressions. Fieldwork is hindered in these areas, especially after heavy rains. Also, tile drainage is more difficult. Included areas make up 2 to 5 percent of the unit.

The Clyde soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow. Tilth is poor. The surface layer puddles readily if it is worked when wet and is hard and cloddy when dry. The content of organic matter is

about 7 to 11 percent in the surface layer. The surface soil and subsoil typically are neutral or slightly acid. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Some areas are used for permanent pasture. If drained, this soil is well suited to corn, soybeans, and small grain. It is wet because of seepage and runoff from soils upslope. Because of the hillside seepage, a drainage system that intercepts laterally moving water is most likely to be successful. Large granite boulders are common in some unimproved areas. They should be removed before crops are grown or drainage tile is installed. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth.

Most of the areas where drainage tile has not been installed are used for permanent pasture. This soil is well suited to pasture and hay. Overgrazing or grazing during wet periods, however, causes surface compaction and excessive puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

98—Huntsville silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on bottom land along small streams. It is subject to rare flooding. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is very dark brown silt loam about 16 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 13 inches thick. The subsoil is brown, friable silt loam about 10 inches thick. The substratum to a depth of about 60 inches is yellowish brown silt loam. It has a few faint brown and strong brown mottles in the lower part. In some areas it is yellowish brown loam or sandy loam.

Included with this soil in mapping are small areas that have received 6 to 18 inches of dark grayish brown and brown silt loam overwash. These areas are near the streams. They are lower in fertility and in content of organic matter than the Huntsville soil. They make up 5 to 10 percent of the unit.

Permeability is moderate. Available water capacity is very high. Surface runoff is slow in cultivated areas. Tilth is good. The content of organic matter is about 3 to 4 percent in the surface layer. The surface soil and subsoil typically are neutral or slightly acid. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. A few are used for pasture. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Flooding is a hazard in some areas. The need for measures that control floodwater varies from area to area because the flooding pattern of some streams was modified when stream channels were deepened and straightened and when roads and road ditches were constructed.

A cover of pasture plants or hay is effective in controlling soil blowing and in maintaining good tilth. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. Both warm-season and cool-season grasses should be included in the pasture rotation.

This soil is well suited to most hardwoods. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by careful site preparation or by spraying or cutting.

The capability class is I.

109B—Backbone fine sandy loam, 2 to 5 percent slopes. This gently sloping, somewhat excessively drained soil is on convex ridges and side slopes in the uplands. Areas are irregularly shaped and are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 19 inches thick. The upper part is brown, very friable fine sandy loam; the next part is brown and dark yellowish brown, friable fine sandy loam and sandy loam; and the lower part is strong brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 27 inches. In some areas the surface layer is very dark grayish brown loamy fine sand.

Permeability is moderately rapid in the upper part of the soil and moderately slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is medium. Tilth is fair. The content of organic matter is 1 to 2 percent in the surface layer. The surface layer and subsoil typically are neutral or slightly acid. The subsoil generally has a low supply of available phosphorus and potassium.

Many areas are used for cultivated crops or for pasture. This soil is poorly suited to cultivated crops, however, because it is droughty, is subject to erosion, and has a limited root zone. Tillage may be difficult because of the shallowness to limestone bedrock. Measures that control runoff and help to prevent excessive soil and moisture losses are needed. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing and water erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing, however, increases the susceptibility to soil blowing and water erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in fairly good condition.

A few areas support native hardwoods. This soil is moderately well suited to trees. Tree seedlings and cuttings grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVs.

109C—Backbone fine sandy loam, 5 to 9 percent slopes. This moderately sloping, somewhat excessively drained soil is on convex ridges and side slopes in the uplands. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 17 inches thick. The upper part is brown, very friable fine sandy loam; the next part is dark yellowish brown, friable sandy loam; and the lower part is dark yellowish brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 25 inches.

Included with this soil in mapping are small areas of moderately eroded soils on the convex side slopes. These soils are lower in content of organic matter and fertility than the Backbone soil. They make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Backbone soil and moderately slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is medium. Tilth is fair. The content of organic matter is about 1 to 2 percent in the surface layer. This layer typically is neutral. The subsoil is neutral or slightly acid. It generally has a low supply of available phosphorus and potassium.

Most areas are pastured. A few are cultivated. This soil is poorly suited to cultivated crops because it is droughty, is subject to erosion, and has a limited root zone. Tillage may be difficult because of the shallowness to limestone bedrock. Cultivated crops should be grown only to reestablish meadows. Measures that control runoff and help to prevent excessive soil and moisture losses are needed. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing and water erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing, however, increases the susceptibility to soil blowing and water erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in fairly good condition.

A few areas support native hardwoods. This soil is moderately well suited to trees. Tree seedlings and cuttings grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVs.

109D—Backbone fine sandy loam, 9 to 14 percent slopes. This strongly sloping, somewhat excessively drained soil is on convex side slopes in the uplands. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is very dark gray fine sandy loam about 7 inches thick. The subsurface layer is dark grayish brown, very friable fine sandy loam about 3 inches thick. The subsoil is about 13 inches thick. The upper part is brown, very friable fine sandy loam; the next part is dark yellowish brown, friable sandy loam; and the lower part is dark yellowish brown and yellowish brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 23 inches.

Permeability is moderately rapid in the upper part of the soil and moderately slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is rapid. Tilth is poor. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is neutral in the surface layer and neutral or slightly acid in the subsurface layer and subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used for pasture or trees. This soil generally is unsuitable for cultivated crops because it is subject to erosion and is droughty.

A cover of pasture plants or hay helps to control erosion. Overgrazing, however, increases the susceptibility to soil blowing and water erosion. The number of livestock that can graze the pasture without damaging the plant cover is low. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in fairly good condition.

A few areas support native hardwoods. This soil is moderately well suited to trees. Tree seedlings and cuttings grow well if competing vegetation is controlled by careful site preparation or by cutting.

The capability subclass is VIs.

110—Lamont fine sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on high stream benches along the Mississippi River. Areas are about 10 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown fine sandy loam about 7 inches thick. The subsurface layer is grayish brown, very friable loamy fine sand about 8 inches thick. The subsoil is about 45 inches thick. The upper part is brown, very friable very fine sandy loam; the next part is brown, friable sandy loam; and the lower part is brown, very friable loamy fine sand that has bands of sandy loam. In some areas the surface layer is dark grayish brown loamy fine sand.

Permeability is moderately rapid in the upper part of the soil and rapid in the lower part of the subsoil. Available water capacity is moderate. Surface runoff is slow. Tilth is fair. The content of organic matter is 0.5 to 1.0 percent in the surface layer. Reaction typically is medium acid in the surface layer and strongly acid in the subsurface layer and subsoil. The subsoil generally has a

high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture, but it is droughty unless rainfall is very timely. Also, soil blowing is a hazard if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing and conserves moisture.

A cover of pasture plants or hay also is effective in controlling soil blowing. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately well suited to trees. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIs.

110B—Lamont fine sandy loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on ridges and side slopes on uplands and stream benches. Areas are about 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray fine sandy loam about 2 inches thick. The subsurface layer is grayish brown fine sandy loam about 6 inches thick. The subsoil is about 28 inches thick. It is yellowish brown and friable. The upper part is fine sandy loam, and the lower part is sandy loam. The substratum to a depth of about 60 inches is yellowish brown loamy fine sand that has thin bands of brown and dark brown, friable sandy loam. In some areas the surface layer is very dark grayish brown sandy loam about 6 inches thick. In other areas it is dark grayish brown loamy fine sand.

Included with this soil in mapping are small areas of the excessively drained Chelsea soils. These soils are more droughty than the Lamont soil and have a lower content of organic matter in the surface layer. They make up less than 10 percent of the unit.

Permeability is moderately rapid in the subsoil of the Lamont soil and rapid in the coarse textured substratum. Available water capacity is moderate. Surface runoff is medium. Tilth is fair. The content of organic matter is 0.5 to 1.0 percent in the surface layer. Reaction typically is medium acid in the surface layer and medium acid or strongly acid in the subsurface layer and the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture or trees. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture, but it is droughty unless rainfall is very timely. Also, soil blowing and water erosion are hazards if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing and water erosion and conserves moisture.

A cover of pasture plants or hay also helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

Some areas support native hardwoods. This soil is moderately well suited to trees. Tree seedlings and cuttings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

110C—Lamont fine sandy loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on ridges and side slopes on uplands and stream benches. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is dark gray fine sandy loam about 2 inches thick. The subsurface layer is grayish brown fine sandy loam about 5 inches thick. The subsoil is about 26 inches thick. It is yellowish brown and friable. The upper part is fine sandy loam, and the lower part is sandy loam. The substratum to a depth of about 60 inches is yellowish brown loamy fine sand that has thin bands of brown and dark brown, friable sandy loam. In some areas the surface layer is brown loamy sand.

Included with this soil in mapping are small areas of the excessively drained Chelsea soils. These soils are more droughty than the Lamont soil and have a lower content of organic matter in the surface layer. They make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the subsoil of the Lamont soil and rapid in the coarse textured substratum. Available water capacity is moderate. Surface runoff is medium in cultivated areas. Tilth is fair. The content of organic matter is 0.5 to 1.0 percent in the surface layer. Reaction typically is medium acid in the surface layer and medium acid or strongly acid in the subsurface layer and the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture or trees. A few are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture, but it is droughty. Also, soil blowing and water erosion are hazards if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing and water erosion and conserves moisture.

A cover of pasture plants or hay also helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff,

and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

Some areas support native hardwoods. This soil is moderately well suited to trees. Tree seedlings and cuttings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

120B—Tama silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on broad, convex ridges in the uplands. Areas are irregularly shaped and generally are 20 to 40 acres or more in size.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown silt loam about 11 inches thick. The subsoil is about 33 inches thick. It is friable. The upper part is brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown. In some areas the surface layer is dark brown and very dark grayish brown silt loam about 8 inches thick.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is medium. Tilth is good, but the soil tends to crust or puddle after heavy rainfall. The content of organic matter is about 3 to 4 percent in the surface layer. This layer typically is neutral or slightly acid. The subsoil is medium acid or strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and stripcropping help to prevent excessive soil loss. In most areas slopes are long enough and uniform enough for terracing. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

120C—Tama silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex side slopes in the uplands. Areas are elongated and generally are 5 to 10 acres in size.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown silt loam about 6 inches thick. The subsoil is about 31 inches thick. It is friable. The upper part is brown and dark yellowish brown silty clay loam, the next part is dark yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown.

Included with this soil in mapping are small areas of moderately eroded soils in similar positions on the landscape. These soils are lower in content of organic matter and fertility than the Tama soil. Also, they have a thinner surface layer. They make up less than 10 percent of the unit.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is medium. Tilth is good, but the soil tends to crust or puddle after hard rains. The content of organic matter is about 3 to 4 percent in the surface layer. This layer typically is neutral or slightly acid. The subsoil is strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and stripcropping help to prevent excessive soil loss. Slopes generally are long enough and uniform enough for terracing. Grassed waterways are needed to prevent the formation of gullies. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

129B—Arenzville-Chaseburg silt loams, 1 to 5 percent slopes. These gently sloping, moderately well drained and well drained soils are in narrow upland drainageways. They are subject to flooding. Areas are about 100 to 200 feet wide and are long or irregularly shaped. They range from 25 to several hundred acres in size. They are about 50 percent Arenzville soil and 40 percent Chaseburg soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Arenzville soil has a surface layer of dark grayish brown silt loam about 7 inches thick. The

substratum is dark grayish brown, brown, and grayish brown silt loam about 21 inches thick. Below this is an old buried surface layer of black silt loam about 17 inches thick. The underlying material to a depth of about 60 inches is very dark grayish brown loam.

Typically, the Chaseburg soil has a surface layer of dark grayish brown silt loam about 4 inches thick. The substratum to a depth of more than 60 inches is multicolored, friable silt loam.

Included with these soils in mapping are small areas of the somewhat poorly drained Orion soils near the center of the drainageways. These included soils make up about 10 percent of the unit.

The Arenzville and Chaseburg soils are moderately permeable. They have a seasonal high water table. Available water capacity is high or very high. Surface runoff is medium. Tilth is good, but the soils tend to crust after heavy rainfall. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. The soils typically are neutral or slightly acid throughout. The Arenzville soil generally has a low supply of available phosphorus and a very low supply of available potassium. The Chaseburg soil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are pastured or cultivated along with the surrounding upland soils. Individual areas generally are too small to be cropped separately. If protected from flooding and erosion, these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. They receive high velocity, concentrated runoff from the adjoining, more sloping upland soils. They can be protected from this excess water by diversion terraces on the adjoining upland slopes. In some areas they are seasonally wet because of seepage from the upland slopes. Installing tile in these areas improves the timeliness of fieldwork. Structures that keep gullies from forming are needed in some areas.

Many small, inaccessible areas along narrow drainageways are used as permanent pasture. These soils are suited to pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

These soils are well suited to most trees. Because they receive runoff from the more sloping upland soils, however, they tend to remain wet for moderately long periods after rainfall. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by site preparation or by spraying or cutting.

The capability subclass is IIe.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land along small streams. It is subject to flooding during periods of heavy rainfall. Areas are 15 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 6 inches thick. The subsurface layer is black and very dark gray silty clay loam about 44 inches thick. The substratum to a depth of about 60 inches is dark gray silty clay loam mottled with olive gray. In some areas it is dark gray silt loam.

Included with this soil in mapping are small areas of soils that have received 6 to 18 inches of dark grayish brown silt loam overwash. These soils are lower in organic matter content and fertility than the Colo soil. They make up less than 10 percent of the unit.

The Colo soil is moderately permeable. It has a seasonal high water table. Available water capacity is high or very high. Surface runoff is very slow or ponded. Tilth is fair. The soil puddles readily when wet and is cloddy and hard when dry. The content of organic matter is about 5 to 7 percent in the surface layer. The soil typically is neutral or slightly acid throughout. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Some are used as permanent pasture. If drained and protected from flooding, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is wet as a result of the flooding, the very slow or ponded runoff, and the seasonal high water table. The flooding damages crops in some years. Drainage tile can function adequately if outlets are available. Diversion terraces help to control floodwater.

The frequently flooded areas are used mainly as pasture. Overgrazing or grazing during wet periods causes excessive puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

136—Ankeny fine sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on low stream benches and foot slopes at the base of the uplands. It is subject to flooding. Areas are about 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown fine sandy loam about 8 inches thick. The subsurface layer is black and very dark brown fine sandy loam about 28 inches thick. The subsoil is dark brown, very friable loamy fine sand about 12 inches thick. The substratum to a depth of about 60 inches is brown fine sand.

Included with this soil in mapping are small areas of soils that have a loamy sand surface layer. These soils are on the stream benches. They are more droughty and less productive than the Ankeny soil. They make up 5 to 8 percent of the unit.

Permeability is rapid in the Ankeny soil. Available water capacity is moderate or high. Surface runoff is slow. Tilth is good. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface soil and the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. A few areas are used as permanent pasture. If it is protected from local runoff and receives timely rainfall during the growing season, this soil is suited to corn, soybeans, and small grain. It receives runoff from the adjoining uplands during periods of heavy rainfall. In some areas diversion terraces help to control the overflow from the higher elevations and the resulting siltation. Droughtiness is a limitation in years when rainfall is below average or is not timely. A system of conservation tillage that leaves crop residue on the surface conserves moisture.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

142—Chaseburg silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on narrow bottom land and alluvial fans below more sloping loess-covered soils in the uplands. It is subject to flooding. Areas are elongated and range from 10 to 40 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The substratum to a depth of more than 60 inches is multicolored, friable silt loam.

This soil is moderately permeable. It has a seasonal high water table. Available water capacity is very high. Surface runoff is slow. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. The soil typically is neutral throughout. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are pastured. A few are cultivated. If protected from flooding, this soil is well suited to corn, soybeans, and small grain. It receives high velocity floodwater during periods of heavy rainfall. The floodwater damages crops in some years. It can be controlled by levees and dikes.

Many narrow, frequently flooded areas are used as permanent pasture. This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing during wet periods after flooding, however, causes surface compaction and puddling. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees, but it is subject to overflow from more sloping upland soils and to the resulting siltation. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIw.

158—Dorchester silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is in narrow valleys on bottom land and on wide river bottom land between limestone bluffs. It is subject to flooding. Areas are irregularly shaped and range from 10 to 60 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The substratum is dark grayish brown, grayish brown, and brown, stratified silt loam about 23 inches thick. Below this to a depth of 60 inches is an old buried surface layer of black and very dark brown silt loam. In some areas the substratum extends to a depth of more than 60 inches.

Included with this soil in mapping are small areas of soils that are stratified with silt and sand throughout. These soils are on the wide bottom land. They tend to be droughty in years of below average rainfall. They make up about 10 percent of the unit.

Permeability is moderate in the Dorchester soil. Available water capacity is very high. Surface runoff is slow. Tilth is good, but the soil tends to puddle or crust after heavy rainfall. The content of organic matter is about 0.5 to 1.0 percent in the recent stratified sediments. Reaction typically is mildly alkaline in these sediments and neutral in the buried surface layer. The supply of available phosphorus generally is low and the supply of available potassium very low.

Most areas along the narrow valleys are pastured, but the broader areas along rivers are cultivated. If protected from flooding, this soil is well suited to corn, soybeans, and small grain. Diversion terraces are needed in some cropped areas to prevent the deposition of new sediments. The need for flood protection varies from area to area because the pattern of stream overflow was modified when stream channels were deepened and straightened and roads and road ditches were constructed.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately well suited to most hardwoods. Because it is subject to flooding, it remains wet for moderately long periods after heavy rainfall. Seedling mortality is moderate. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIw.

162B—Downs silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on narrow ridges in the uplands. Areas are irregularly shaped and range from 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown silt loam. The next part is dark yellowish brown and yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with strong brown and grayish brown.

Included with this soil in mapping are some small areas of Tama soils along ridges at the head of drainageways. These soils have a surface layer that is darker, thicker, and higher in content of organic matter than that of the Downs soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Downs soil. Available water capacity is high or very high. Surface runoff is medium in cultivated areas. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. Slopes generally are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIe.

162C—Downs silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow ridges and long, convex side slopes in the uplands. Areas are irregularly shaped and range from 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown and dark brown silt loam about 8 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown and dark yellowish brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with strong brown and grayish brown.

Included with this soil in mapping are small areas, on the convex side slopes, where the soil is moderately eroded, the content of organic matter is lower, and tilth is poorer. Included areas make up about 6 to 10 percent of the unit.

Permeability is moderate in the Downs soil. Available water capacity is high or very high. Surface runoff is medium in cultivated areas. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

A few areas support native hardwoods. This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

162C2—Downs silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on narrow ridges and long, convex side

slopes in the uplands. Areas are irregularly shaped and range from 10 to more than 80 acres in size.

Typically, the surface layer is mixed very dark grayish brown and brown silt loam about 8 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is dark yellowish brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with strong brown and grayish brown. In some areas the surface layer is brown silty clay loam. In other areas it is very dark brown silt loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is medium in cultivated areas. Tilth is fair. The soil tends to crust after heavy rainfall and clods and puddles if it is tilled when wet. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Further erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

162D—Downs silt loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on long, convex side slopes in the uplands. Areas are irregularly shaped and are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown and strong brown. In some areas the surface layer is only about 5 inches thick.

Included with this soil in mapping are small areas of Luana and Mottland soils near the base of the side slopes. Luana soils formed in 20 to 40 inches of loess and in the underlying residuum of limestone. Mottland soils formed in loess or loamy sediments 7 to 20 inches deep over material weathered from limestone. Included soils make up less than 5 percent of the unit.

Permeability is moderate in the Downs soil. Available water capacity is high or very high. Surface runoff is medium or rapid in cultivated areas. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas have been cleared of trees and are cultivated. A few areas are pastured. This soil is suited to corn and soybeans grown occasionally in rotation with small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

A few areas support native hardwoods. This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

162D2—Downs silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on long, convex side slopes in the uplands. Areas are elongated and are 10 to 30 acres in size.

Typically, the surface layer is mixed very dark grayish brown and brown silt loam about 8 inches thick. The subsoil is about 34 inches thick. It is friable. The upper part is dark yellowish brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of

about 60 inches is yellowish brown silt loam mottled with grayish brown and strong brown. In some areas the surface layer is brown silty clay loam.

Included with this soil in mapping are small areas of Luana and Mottland soils near the base of the side slopes. Luana soils formed in 20 to 40 inches of loess and in the underlying residuum of limestone. Mottland soils formed in loess or loamy sediments 7 to 20 inches deep over material weathered from limestone. Included soils make up less than 5 percent of the unit.

Permeability is moderate in the Downs soil. Available water capacity is high or very high. Surface runoff is rapid. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans grown occasionally in rotation with small grain and to grasses and legumes for hay and pasture. Further erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

162E2—Downs silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on short, convex side slopes in the uplands. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is mixed very dark grayish brown and brown silt loam about 8 inches thick. The subsoil is about 32 inches thick. It is yellowish brown and friable. The upper part is silty clay loam, and the lower part is silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown and strong brown. In some areas the surface layer is brown silty clay loam.

Included with this soil in mapping are some small areas of Mottland soils near the base of the side slopes. These soils formed in loess or loamy sediments 7 to 20 inches deep over material weathered from limestone. They make up less than 5 percent of the unit.

Permeability is moderate in the Downs soil. Available water capacity is high or very high. Surface runoff is rapid in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. A few are pastured. This soil is suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. Further erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. Slopes generally are too short and too steep for terracing. In some areas, however, the soil can be terraced along with the less sloping soils upslope. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVe.

163B—Fayette silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex, moderately wide ridgetops. Areas are irregularly shaped and range from 20 to 80 acres in size.

Typically, the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is grayish

brown silt loam about 7 inches thick. The subsoil is about 40 inches thick. It is friable. The upper part is brown silty clay loam, the next part is dark yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is medium in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIe.

163C—Fayette silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow ridges and long, convex side slopes. Areas are irregularly shaped and range from 10 to 50 acres in size.

Typically, the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is grayish brown, friable silt loam about 7 inches thick. The subsoil is about 39 inches thick. It is friable. The upper part is brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam mottled with grayish brown and strong brown. In some areas the surface layer is dark grayish brown silt loam about 7 inches thick.

Included with this soil in mapping are small areas, on the convex side slopes, where the soil is moderately eroded, the content of organic matter is lower, and tilth is poorer. Included areas make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high or very high. Surface runoff is medium in cultivated areas. Tilth is fair. The soil tends to crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and very strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

Many areas support native hardwoods. This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

163C2—Fayette silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on narrow ridges and long, convex side slopes. Areas are irregularly shaped and range from 20 to 80 acres or more in size.

Typically, the surface layer is mixed dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 35 inches thick. It is friable. The upper part is dark yellowish brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown. In some areas the surface layer is brown silty clay loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is medium or rapid in cultivated areas. Tilth is fair. The soil can be easily tilled

but tends to crust or puddle after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Further erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Tree cuttings and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

163D—Fayette silt loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on long, convex side slopes. Areas are elongated and range from 10 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark gray and dark grayish brown silt loam about 8 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam mottled with grayish brown. In some areas the surface layer is dark grayish brown silt loam about 7 inches thick.

Included with this soil in mapping are small areas of Lindley soils on the lower part of the side slopes. These soils contain more sand than the Fayette soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high or very high. Surface runoff is rapid in cultivated areas. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are wooded or are used as permanent pasture. A few have been cleared of trees and are cultivated. This soil is suited to corn and soybeans grown in rotation with small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

Many areas support native hardwoods. This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

163D2—Fayette silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on narrow ridges and long, convex side slopes. Areas are elongated and range from 10 to 40 acres in size.

Typically, the surface layer is mixed dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 35 inches thick. It is friable. The upper part is dark yellowish brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown.

Included with this soil in mapping are small areas of Dubuque soils and severely eroded Fayette soils. These soils are on the convex side slopes. Dubuque soils are 20 to 30 inches deep over limestone. The severely eroded Fayette soils have a lower content of organic matter than this Fayette soil. Also, tilth is poorer. Included soils make up less than 10 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high or very high. Surface runoff is rapid. Tilth is fair. The soil can be easily tilled but tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 0.5 to 1.0 percent

in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. A few are pastured. This soil is suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. Further erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and grassed waterways help to prevent excessive soil loss (fig. 14). Slopes commonly are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

163D3—Fayette silty clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on short, convex side slopes. Areas are elongated and range from 10 to 20 acres in size.

Typically, the surface layer is brown silty clay loam about 8 inches thick. The subsoil is about 32 inches thick. It is yellowish brown and friable. The upper part is silty clay loam, and the lower part is silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown. In some areas the surface layer is dark grayish brown and brown silt loam.

Permeability is moderate. Available water capacity is high. Surface runoff is rapid. Tilth is poor. The soil is cloddy after it has been worked when wet and tends to

Figure 14.—Contour stripcropping and grassed waterways on Fayette silt loam, 9 to 14 percent slopes, moderately eroded.

puddle during periods of heavy rainfall. The puddling increases the runoff rate and retards plant growth. The content of organic matter is less than 0.5 percent in the surface layer. Reaction typically is medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. In a few areas slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. More nitrogen generally is needed on this soil than on less eroded Fayette soils. Also, more intensive management is needed to maintain productivity and improve tilth.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVe.

163E—Fayette silt loam, 14 to 18 percent slopes. This moderately steep, well drained soil is on long, convex side slopes. Areas are elongated and range from 10 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark gray and dark grayish brown silt loam about 8 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown. In some areas the surface layer is dark grayish brown silt loam about 7 inches thick.

Included with this soil in mapping are small areas of red clay and small areas of Lindley soils. These included areas are on the lower part of the side slopes. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high or very high. Surface runoff is rapid in cultivated areas. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas support native hardwoods. Some are used as permanent pasture. This soil is suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. Corn and soybeans are grown only to establish legumes. If cultivated crops are grown, erosion is a serious hazard. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment.

The capability subclass is IVe.

163E2—Fayette silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on short, convex side slopes. Areas are elongated and range from 5 to 20 acres in size.

Typically, the surface layer is mixed dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 34 inches thick. It is friable. The upper part is dark yellowish brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown. In some areas the surface layer is brown silty clay loam.

Included with this soil in mapping are some small areas of Dubuque and Nordness soils on the lower part of the side slopes. Dubuque soils are underlain by limestone bedrock at a depth of 20 to 30 inches. Nordness soils are underlain by limestone bedrock at a depth of 8 to 20 inches. Included soils make up less than 10 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high or very high. Surface runoff is rapid in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 0.5 to 1.0 percent in the surface layer.

Many areas are cultivated. A few are pastured. This soil is suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment.

The capability subclass is IVe.

163E3—Fayette silty clay loam, 14 to 18 percent slopes, severely eroded. This moderately steep, well drained soil is on short, convex side slopes dissected by gullies and waterways. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is brown silty clay loam about 8 inches thick. The subsoil is about 30 inches thick. It is yellowish brown and friable. The upper part is silty clay loam, and the lower part is silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown. In some areas the surface layer is dark grayish brown and brown silt loam.

Included with this soil in mapping are small areas of Lindley soils on the lower part of the side slopes. These soils have a loam surface layer. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high. Surface runoff is rapid. Tilth is poor. The soil is cloddy after it has been worked when wet and tends to puddle during periods of heavy rainfall. The puddling increases the runoff rate and retards plant growth. The content of organic matter is less than 0.5 percent in the surface layer. Reaction typically is medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are used as permanent pasture. This soil generally is unsuitable for cultivated crops because of a serious hazard of further erosion. These crops should be grown only to reestablish grasses and legumes for hay and pasture. More nitrogen generally is needed on this soil than on less eroded Fayette soils. Also, more intensive management is needed to improve productivity and tilth. A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails and roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment.

The capability subclass is VIe.

163F—Fayette silt loam, 18 to 25 percent slopes. This steep, well drained soil is on short, convex side slopes. Areas are elongated and range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark gray and dark grayish brown silt loam about 8 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown. In some areas the surface layer is dark grayish brown silt loam about 7 inches thick.

Included with this soil in mapping are small areas of Dubuque and Nordness soils on the lower part of the side slopes. Dubuque soils are 20 to 30 inches deep over limestone bedrock. Nordness soils are 8 to 20 inches deep over limestone bedrock. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high or very high. Surface runoff is rapid. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available

phosphorus and a very low supply of available potassium.

Most areas support native hardwoods. Some are used as permanent pasture. This soil generally is not suited to cultivated crops and is only moderately well suited to hay. Operating farm machinery is difficult because of the slope and because of gullies and waterways. If cultivated crops are grown, erosion is a serious hazard. A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment.

The capability subclass is VIe.

163F2—Fayette silt loam, 18 to 25 percent slopes, moderately eroded. This steep, well drained soil is on short, convex side slopes. Areas are elongated and range from 5 to 20 acres in size.

Typically, the surface layer is mixed dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 33 inches thick. It is friable. The upper part is dark yellowish brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam mottled with grayish brown. In some areas the surface layer is brown silty clay loam.

Included with this soil in mapping are small areas of Dubuque and Nordness soils on the lower part of the side slopes. Dubuque soils are 20 to 30 inches deep over limestone bedrock. Nordness soils are 8 to 20 inches deep over limestone bedrock. Included soils make up about 6 to 10 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high or very high. Surface runoff is rapid in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are pastured. This soil generally is not suited to cultivated crops and is only moderately well suited to hay. Operating farm machinery is difficult because of the slope and because of gullies and waterways. If cultivated crops are grown, further erosion is a serious hazard. These crops should be grown only to reestablish grasses and legumes for hay and pasture.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment.

The capability subclass is VIe.

163F3—Fayette silty clay loam, 18 to 25 percent slopes, severely eroded. This steep, well drained soil is on short, convex side slopes dissected by gullies and waterways. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is brown silty clay loam about 8 inches thick. The subsoil is about 30 inches thick. It is yellowish brown and friable. The upper part is silty clay loam, the next part is silt loam, and the lower part is silt loam mottled with grayish brown. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam mottled with grayish brown. In some areas the surface layer is dark grayish brown and brown silt loam.

Included with this soil in mapping are small areas of Lindley soils on the lower part of the side slopes. These soils have a loam surface layer. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high. Surface runoff is rapid. Tilth is poor. The soil is cloddy after it has been worked when wet and tends to puddle during periods of heavy rainfall. The puddling increases the runoff rate and retards plant growth. The content of organic matter is less than 0.5 percent in the surface layer. Reaction typically is medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are used as permanent pasture. This soil generally is not suited to cultivated crops and is only moderately well suited to hay. Operating farm machinery is difficult because of the slope and the gullies and waterways. If cultivated crops are grown, further erosion is a serious hazard. These

crops should be grown only to reestablish grasses and legumes for hay and pasture.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment.

The capability subclass is VIe.

163G—Fayette silt loam, 25 to 40 percent slopes. This very steep, well drained soil is on short, convex side slopes. Areas are elongated and range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is gray and dark grayish brown silt loam about 6 inches thick. The subsoil is about 34 inches thick. It is friable. The upper part is brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown. In some areas the surface layer is dark grayish brown and is about 6 inches thick.

Included with this soil in mapping are small areas of Nordness soils. These soils are 8 to 20 inches deep over limestone bedrock. They make up less than 10 percent of the unit.

Permeability is moderate in the Fayette soil. Available water capacity is high or very high. Surface runoff is rapid. Tilth is fair. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Nearly all areas are wooded or used as permanent pasture. This soil generally is not suited to cultivated crops or to hay. It is poorly suited to pasture. Ordinary farm machinery cannot be used because of the very steep slope.

Most areas support native hardwoods. This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment.

The capability subclass is VIIe.

171B—Bassett loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on long, convex ridges and side slopes in the uplands. Areas are irregularly shaped and are 10 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is brown loam about 6 inches thick. The subsoil is loam about 39 inches thick. The upper part is yellowish brown and friable; the next part is yellowish brown, is mottled with grayish brown and brown, and is firm; and the lower part is mottled yellowish brown and grayish brown and is firm. The substratum to a depth of about 60 inches is mixed yellowish brown and grayish brown loam mottled with strong brown. In some areas the surface layer is dark grayish brown.

Included with this soil in mapping are a few small areas of sandy soils on the convex side slopes. These soils are droughty in years of below average rainfall. They make up less than 5 percent of the unit.

Permeability is moderate in the Bassett soil. Available water capacity is high. Surface runoff is medium in cultivated areas. Tilth is good. The content of organic matter is about 2 or 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent deterioration of tilth.

Some of the measures that help to control erosion tend to increase the wetness of this soil. Contour farming and terracing, for example, slow down the movement of surface water. As a result, more of the water soaks into the soil and the water table may be temporarily high. A combination of terracing and tiling is needed in some areas. If terraces are built, as little glacial till as possible should be exposed. The glacial till is low in fertility and cannot be easily tilled.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIe.

171C2—Bassett loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on short, convex side slopes in the uplands. Areas are elongated and are about 5 to 10 acres in size.

Typically, the surface layer is mixed very dark grayish brown and brown loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is loam about 32 inches thick. The upper part is yellowish brown and friable; the next part is yellowish brown, has a few grayish brown mottles, and is firm; and the lower part is mottled yellowish brown and grayish brown and is firm. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown loam. In some areas the surface layer is brown loam.

Included with this soil in mapping are a few small areas of sandy soils on the side slopes. These soils are more droughty than the Bassett soil and are lower in fertility. They make up less than 2 percent of the unit.

Permeability is moderate in the Bassett soil. Available water capacity is high. Surface runoff is medium or rapid in cultivated areas. Tilth generally is fair. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. If well managed, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Further erosion is a severe hazard, however, if cultivated crops are grown. More nitrogen generally is needed on this soil than on less eroded Bassett soils. Also, more intensive management is needed to maintain productivity and tilth. Contour farming and terracing help to control erosion. Fieldwork is slightly delayed during some wet periods.

Some of the measures that help to control erosion tend to increase the wetness of this soil. They slow down the movement of surface water. As a result, more of the water soaks into the soil. Hillside seepage can occur because the soil is more permeable in the upper part of the subsoil than in the lower part and the substratum. A combination of measures is needed in some areas. An example is tile drainage in combination with terraces or a system of conservation tillage that leaves crop residue on the surface.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

177—Saude loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream benches. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown and brown, friable loam; the next part is dark yellowish brown, friable sandy loam; and the lower part is brown, loose gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown gravelly sand.

Included with this soil in mapping are small areas where coarse sand and gravel are within a depth of 20 inches and the soil is more droughty. These areas are near the edge of the stream benches. They make up less than 7 percent of the unit.

Permeability is moderate in the upper part of the Saude soil and very rapid in the lower part. Available water capacity is moderate. Surface runoff is slow. Tilth is good. The content of organic matter is about 3 to 4 percent in the surface layer. Reaction typically is slightly acid or neutral in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Some are pastured. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It can be tilled easily, but it is somewhat droughty, particularly in years of average or below average rainfall. The hazard of erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserves moisture.

The pastured areas can be easily overstocked because the available water capacity is only moderate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

177B—Saude loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream benches. Areas are irregularly shaped and range from 2 to 10 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 5 inches thick. The subsoil is about 24 inches thick. The upper part is brown, friable loam; the next part is dark yellowish brown, friable sandy

loam; and the lower part is brown, loose gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown gravelly sand.

Included with this soil in mapping are small areas where the depth to coarse sand and gravel is more than 32 inches and the soil is less droughty. These areas are on the benches near the uplands. They make up less than 5 percent of the unit.

Permeability is moderate in the upper part of the Saude soil and very rapid in the lower part. Available water capacity is moderate. Surface runoff is medium. Tilth is good. The content of organic matter is about 3 to 4 percent in the surface layer. Reaction typically is slightly acid or neutral in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Some are pastured. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard if cultivated crops are grown. Also. droughtiness is a limitation, especially in years of average or below average rainfall. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Because of short and irregular slopes, contour farming generally is difficult. The soil is not well suited to terracing because the substratum is coarse textured.

A cover of pasture plants or hay helps to control erosion. The pastured areas can be easily overstocked because the available water capacity is only moderate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

178—Waukee loam, 0 to 2 percent slopes. This nearly level, well drained soil is on alluvial benches along streams, generally below limestone bluffs or strongly sloping upland soils. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 10 inches thick. The subsoil is about 21 inches thick. It is friable. The upper part is dark yellowish brown loam, and the lower part is yellowish brown sandy clay loam. The substratum to a depth of about 60 inches is yellowish brown sand and gravelly sand.

Included with this soil in mapping are small areas of soils that have a thinner, lighter colored surface layer and are lower in organic matter content and fertility. These soils are on the benches near the uplands. They make up less than 5 percent of the unit.

Permeability is moderate in the upper part of the Waukee soil and very rapid in the substratum. Available water capacity is moderate. Surface runoff is slow in cultivated areas. Tilth is good. The soil warms up quickly in the spring and can be worked soon after rainfall. The content of organic matter is about 3 to 4 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface soil and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Some are pastured. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It can be easily tilled, but it is somewhat droughty in years of below average rainfall or during extended dry periods. The hazard of erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

The pastured areas can be easily overstocked because available water capacity is only moderate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

183C—Dubuque silt loam, 20 to 30 inches to limestone, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow ridges in the uplands. Areas are elongated and range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 8 inches thick. The subsoil is about 14 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is yellowish brown, friable silty clay loam; and the lower part is brown, very firm clay. Hard limestone bedrock is at a depth of about 25 inches. In some areas the surface layer is dark grayish brown silt loam about 8 inches thick.

Included with this soil in mapping are small areas where the depth to limestone bedrock is 30 to 40 inches. These areas are near the center of the ridges. They make up about 5 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is medium or rapid. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid in the surface soil and medium acid in the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are wooded or are used as permanent pasture. A few are cultivated. This soil is suited to occasional cultivated crops. Erosion is a hazard, however, if cultivated crops are grown. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone. A scarcity of moisture is likely to damage crops unless rainfall is timely during the growing season. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways help to prevent excessive soil loss. The soil is not well suited to terracing because the bedrock may interfere with construction. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

Many areas support native hardwoods. This soil is well suited to trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting. The penetration of tree roots may be limited by the limestone bedrock.

The capability subclass is IIIe.

183D—Dubuque silt loam, 20 to 30 inches to limestone, 9 to 14 percent slopes. This strongly sloping, well drained soil is on short, convex side slopes in the uplands. Areas are elongated and range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark grayish brown and brown, friable silt loam about 8 inches thick. The subsoil is about 14 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is yellowish brown, friable silty clay loam; and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 25 inches. In some areas the depth to limestone is about 15 to 20 inches.

Permeability is moderate in the upper part of the soil and slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is rapid. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid in the surface soil and medium acid in the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are wooded or are used as permanent pasture. This soil is suited to occasional cultivated crops. Erosion is a hazard, however, if cultivated crops are grown. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone. A scarcity of moisture is likely to damage crops unless rainfall is timely during the growing season. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways help to prevent excessive soil loss. The soil is not well suited to terracing because the bedrock may interfere with construction. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

Many areas support native hardwoods. This soil is well suited to trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting. The penetration of tree roots may be limited by the limestone bedrock.

The capability subclass is IVe.

183D2—Dubuque silt loam, 20 to 30 inches to limestone, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on short, convex side slopes in the uplands. Areas are elongated and range from 5 to 20 acres in size.

Typically, the surface layer is mixed dark grayish brown and brown silt loam about 6 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 20 inches thick. The upper part is yellowish brown, friable silt loam; the next part is yellowish brown, friable and firm silty clay loam; and the lower part is mixed brown and reddish brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 26 inches.

Included with this soil in mapping are areas where the depth to limestone is 30 to 40 inches and the soil is less droughty. These areas are on the upper parts of the side slopes. They make up less than 3 percent of the unit. Also included are small areas where the soil is severely eroded and the content of organic matter is lower. These areas make up less than 6 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is rapid. Tilth is fair. The soil is cloddy after it has been worked when wet and tends to crust after heavy rainfall. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. This layer typically is slightly acid. The subsoil is medium acid. It generally has a medium supply

of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. This soil is poorly suited to cultivated crops. It is highly susceptible to erosion if it is cultivated. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone. A scarcity of moisture is likely to damage crops unless rainfall is timely during the growing season. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways help to prevent excessive soil loss. The soil is not well suited to terracing because the bedrock may interfere with construction. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

A few areas support native hardwoods. This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting. The penetration of tree roots may be limited by limestone bedrock.

The capability subclass is IVe.

183E—Dubuque silt loam, 20 to 30 inches to limestone, 14 to 18 percent slopes. This moderately steep, well drained soil is on short, convex side slopes in the uplands. Areas are elongated and range from 5 to 15 acres in size.

Typically, the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is dark grayish brown and brown, friable silt loam about 7 inches thick. The subsoil is about 14 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is yellowish brown, friable silty clay loam; and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 23 inches. In some areas the surface layer is dark grayish brown silt loam about 7 inches thick.

Included with this soil in mapping are small areas of Nordness soils on the lower parts of the side slopes. These soils are 8 to 20 inches deep over limestone bedrock. They make up less than 10 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is rapid. Tilth is fair. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid in the surface soil and medium acid in the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are wooded or are used as permanent pasture. This soil generally is not suited to cultivated crops and is only moderately well suited to hay. If cultivated crops are grown, erosion is a severe hazard. These crops should be grown only to reestablish pasture. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

Many areas support native hardwoods. This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. The penetration of tree roots may be limited by the limestone bedrock. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating the equipment.

The capability subclass is VIe.

183E2—Dubuque silt loam, 20 to 30 inches to limestone, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on short, convex side slopes in the uplands. Areas are elongated and range from 5 to 15 acres in size.

Typically, the surface layer is mixed dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 14 inches thick. The upper part is yellowish brown, friable silty clay loam, and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 22 inches. In places the surface layer is brown silty clay loam.

Included with this soil in mapping are small areas of Nordness soils on the lower parts of the side slopes. These soils are 8 to 20 inches deep over limestone bedrock. They make up less than 10 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is rapid. Tilth is poor. The soil is cloddy after it has been worked when wet and tends to crust after heavy rainfall. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. This layer typically is slightly acid. The subsoil is medium acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Some are pastured. This soil generally is not suited to cultivated crops and is poorly suited to hay. If cultivated crops are grown, further

erosion is a severe hazard. These crops should be grown only to reestablish pasture. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. The penetration of tree roots may be limited by the limestone bedrock. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating this equipment.

The capability subclass is VIe.

183E3—Dubuque silty clay loam, 20 to 30 inches to limestone, 14 to 18 percent slopes, severely eroded. This moderately steep, well drained soil is on short, convex side slopes in the uplands. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is brown silty clay loam about 7 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 15 inches thick. The upper part is yellowish brown, friable silty clay loam, and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 22 inches.

Included with this soil in mapping are small areas of Nordness soils on the lower parts of the side slopes. These soils are 8 to 20 inches deep over limestone bedrock. They make up less than 10 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is rapid in cultivated areas. Tilth is poor. The soil is cloddy after it has been worked when wet and puddles or crusts after heavy rainfall. The content of organic matter is less than 0.5 percent in the surface layer. The surface layer and subsoil typically are medium acid. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are pastured. This soil generally is not suited to cultivated crops and is poorly suited to hay. If cultivated crops are grown, further erosion is a serious hazard. These crops should be grown only to reestablish pasture. Reestablishing pasture is difficult in some areas because of the many waterways and the moderately steep slope.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to prevent further damage to the pasture and the soil.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Renovating woodland is difficult in many areas because of the waterways and the moderately steep slope. The penetration of tree roots may be limited by the limestone bedrock. Carefully selecting sites for logging trails and roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating the equipment.

The capability subclass is VIIe.

183F—Dubuque silt loam, 20 to 30 inches to limestone, 18 to 25 percent slopes. This steep, well drained soil is on short, convex side slopes in the uplands. Areas are elongated and range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is dark grayish brown and brown, friable silt loam about 7 inches thick. The subsoil is about 14 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is yellowish brown, friable silty clay loam; and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 23 inches. In some areas the surface layer is dark grayish brown and brown silt loam about 8 inches thick.

Included with this soil in mapping are small areas of Nordness soils on the lower parts of the side slopes. These soils are 8 to 20 inches deep over limestone bedrock. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part of the subsoil. Available water capacity is low. Surface runoff is rapid. Tilth is fair. The content of organic matter is about 1 to 2 percent in the surface layer. This layer typically is slightly acid. The subsoil is medium acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are wooded or are used as permanent pasture. This soil generally is not suited to cultivated crops and is poorly suited to pasture. Grazing should be limited.

Many areas support native hardwoods. This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. The penetration of tree roots may be limited by the limestone bedrock. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because

of the slope, special logging equipment is needed. Also, caution is needed in operating the equipment.

The capability subclass is VIIe.

196C—Volney channery silt loam, 5 to 12 percent slopes. This moderately sloping and strongly sloping, well drained and somewhat excessively drained soil is on alluvial fans at the mouth of upland drainageways. It is subject to flooding. Areas are about 5 to 15 acres in size and are long and narrow.

Typically, the surface layer is very dark brown channery silt loam about 11 inches thick. The subsurface layer is about 18 inches of black and very dark brown, channery or very flaggy silt loam. The content of coarse limestone fragments in this layer is 15 to 60 percent. The substratum to a depth of about 60 inches is very dark brown, very dark grayish brown, and brown very flaggy silt loam.

Included with this soil in mapping are areas that have received 6 to 18 inches of recently deposited, lighter colored overwash. The soils in these areas are lower in content of organic matter and fertility than the Volney soil. They are near the drainageways. They make up less than 10 percent of the unit.

Permeability is moderately rapid in the surface layer of the Volney soil and very rapid in the substratum. Available water capacity is moderate. Surface runoff is medium. Tilth is poor because of the coarse limestone fragments in the surface layer. The content of organic matter is about 3 to 5 percent in the surface layer. The soil typically is mildly alkaline or moderately alkaline throughout. The supply of available phosphorus generally is low, and the supply of available potassium very low.

Most areas are used for permanent pasture. A few small areas are cultivated along with the adjacent soils. This soil generally is unsuited to cultivated crops. It occasionally receives high velocity runoff from the steep and very steep soils upslope. The runoff deposits new sediments containing limestone fragments, which interfere with fieldwork. Areas of this soil generally are very difficult to reach with ordinary farm machinery because most areas are below the steep Nordness soil and the very steep Rock outcrop-Nordness complex. Diversions in accessible areas help to protect the soil from local runoff.

This soil is suited to hay and pasture. Flooding and siltation are hazards, however, because of high velocity runoff during periods of heavy rainfall. Grazing during wet periods causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to prevent further damage to the pasture and the soil.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting. Tree growth may be limited by the moderate available water capacity.

The capability subclass is VIs.

213B—Rockton loam, 30 to 40 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and side slopes on uplands or on the higher parts of benchlike areas. Areas are 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark grayish brown loam about 10 inches thick. The subsoil is about 16 inches thick. It is brown. The upper part is friable loam, the next part is friable clay loam, and the lower part is very firm clay. Hard, fractured limestone bedrock is at a depth of about 33 inches.

Included with this soil in mapping are a few small areas where the depth to limestone bedrock is more than 40 inches and the soil is less droughty. These areas are on the convex ridges. They make up less than 5 percent of the unit.

Permeability and available water capacity are moderate in the Rockton soil. Surface runoff is medium. Tilth is good. The content of organic matter is about 2 to 4 percent in the surface layer. Reaction typically is slightly acid in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is subject to erosion, however, and is droughty unless rainfall is timely. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Constructing terraces is difficult in some areas because of the limited depth to limestone bedrock. Returning crop residue to the soil or regularly adding other organic material increases the rate of water infiltration and improves fertility.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

214B—Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and side slopes on uplands or on the higher parts of benchlike areas. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark grayish brown loam about 6 inches thick. The subsoil is about 12 inches thick. It is brown. The upper part is friable loam, the next part is friable clay loam, and the

lower part is very firm clay. Hard, fractured limestone bedrock is at a depth of about 25 inches.

Included with this soil in mapping are small areas where the limestone is near or at the surface and thus hinders fieldwork. These areas are on the lower parts of the side slopes. They make up less than 5 percent of the unit.

Permeability and available water capacity are moderate in the Rockton soil. Surface runoff is medium. Tilth is good. The content of organic matter is about 2 to 4 percent in the surface layer. Reaction typically is slightly acid in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Some are pastured. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is subject to erosion, however, and is droughty in years of average or below average rainfall. The root zone is limited by the depth to limestone. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. The soil is not well suited to terracing because of the limited depth to limestone. Returning crop residue to the soil or regularly adding other organic material increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

215E—Goss loam, 9 to 18 percent slopes. This strongly sloping and moderately steep, well drained and somewhat excessively drained soil is on ridges and side slopes in the uplands. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loam about 3 inches thick. The subsurface layer is dark grayish brown, reddish brown, and dark brown cherty fine sandy loam about 9 inches thick. The subsoil is firm very cherty clay about 48 inches thick. The upper part is dark red, the next part is red, and the lower part is dark red. In some areas the surface layer is dark grayish brown silt loam about 7 inches thick.

Included with this soil in mapping are small areas where cultivation is very difficult because many chert fragments are on the surface. These areas are on the lower parts of the side slopes. They make up about 3 to 8 percent of the unit.

Permeability is moderately rapid in the loamy upper part of the Goss soil and moderate in the subsoil. Available water capacity is low or very low. Surface runoff is rapid in cultivated areas. Tilth is poor because of chert fragments close to the surface. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction is dominantly medium acid or strongly acid in the surface soil and strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are pastured or wooded. A few are cultivated. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is droughty and is subject to erosion if cultivated. Tilling is difficult because of the chert fragments close to the surface. Cultivated crops should be grown only to reestablish pasture. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The chert fragments hinder the construction of terraces. Regularly adding organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants helps to control erosion. Overgrazing, however, causes surface compaction and increases the runoff rate. The maximum stocking rate is very low. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in fairly good condition.

This soil is poorly suited to trees. It is droughty and has a limited root zone. Also, the equipment limitation is moderate because of the slope. Special logging equipment and caution in operating the equipment are needed.

The capability subclass is IVs.

221B—Palms muck, 1 to 4 percent slopes. This nearly level to gently sloping, very poorly drained soil is in spring-fed seepy areas on hillsides and in depressions in upland drainageways. It is subject to ponding. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is black, slightly sticky muck about 8 inches thick. The subsurface layer is black muck about 16 inches thick. The substratum to a depth of about 60 inches is very dark gray and greenish gray silty clay loam. In some areas it is black silt loam.

Included with this soil in mapping are small areas of soils that have received 6 to 18 inches of light colored overwash. Also included are areas of soils that cannot be drained so easily as the Palms soil because the muck is as much as 72 inches thick. The included soils are in the drainageways. They make up less than 10 percent of the unit.

Permeability of the Palms soil is moderately slow in the surface layer and subsurface layer and moderate in the substratum. It has a seasonal high water table near or above the surface. Surface runoff is very slow or ponded. Available water capacity is very high. Tilth is poor. The content of organic matter is about 30 to 45

percent in the spongy surface layer. Reaction typically is slightly acid or neutral in the surface layer and subsurface layer and neutral or mildly alkaline in the substratum. The supply of available phosphorus and potassium generally is very low.

Most areas are pastured or are left idle. A few are cultivated. If adequately drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is wet because of the seasonal high water table and the seepage. Tile drains should be installed in the substratum. If tile is installed in the surface layer or subsurface layer, the organic material settles and shrinks. As a result, the tile is displaced and does not function properly. In some areas obtaining an adequate outlet is difficult. In many areas surface tile inlets or shallow drainage ditches are needed.

In undrained areas this soil is poorly suited to pasture and generally is left idle because the spongy surface layer cannot withstand grazing. In the drained areas used as pasture, stocking or grazing should be restricted during wet periods. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

This soil is poorly suited to trees because of the seasonal high water table and the ponding. The equipment limitation, seedling mortality, and the windthrow hazard are severe. Operating logging machinery is difficult because of the spongy surface layer. Ordinary logging equipment should be used only during the drier periods or during winter, when the ground is frozen. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees.

The capability subclass is IIIw.

225—Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on stream benches below limestone bluffs or more sloping upland soils. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is black loam about 7 inches thick. The subsurface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 13 inches thick. The upper part is dark grayish brown, friable loam mottled with yellowish brown and olive brown; the next part is dark grayish brown, friable loam mottled with strong brown and olive brown; and the lower part is mottled yellowish brown, olive brown, and grayish brown, very friable sandy loam. The substratum to a depth of about 60 inches is dark grayish brown and dark gray gravelly loamy sand.

Included with this soil in mapping are small areas where the surface layer is thinner and lighter colored and the content of organic matter is lower. These areas are near the uplands. They make up less than 5 percent of the unit.

The Lawler soil is moderately permeable in the upper part and very rapidly permeable in the substratum. It has a seasonal high water table. Available water capacity is low or moderate. Surface runoff is slow. Tilth is good. The content of organic matter is about 4 to 5 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. A few are used as permanent pasture. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay or pasture. The fluctuating water table is moderately high in the spring but drops rapidly during the growing season. Tile drainage is beneficial in some areas. The drainage system should be carefully controlled, however, because the soil is somewhat droughty during extended dry periods. Installing the tile is difficult because of the loose, water-bearing sand and gravel. If row crops are intensively grown, erosion is a slight hazard. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

In the areas used as pasture, overstocking or grazing during wet periods can result in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

226—Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on stream benches below limestone bluffs or more sloping upland soils. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 12 inches thick. The subsoil is about 18 inches thick. It is friable. The upper part is dark grayish brown loam mottled with dark brown and brown; the next part is dark grayish brown loam mottled with strong brown, brown, and dark brown; and the lower part is brown sandy loam mottled with dark brown. The substratum to a depth of about 60 inches is strong brown loamy sand mottled with brown. In some areas the surface layer is dark grayish brown loam.

Included with this soil in mapping are small areas of poorly drained soils in slight depressions in the stream benches. The wetness in these areas delays fieldwork

unless tile drains are installed. These soils make up less than 5 percent of the unit.

The Lawler soil is moderately permeable in the upper part and very rapidly permeable in the substratum. It has a seasonal high water table. Available water capacity is moderate. Surface runoff is slow. Tilth is good. The content of organic matter is about 4 to 5 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. A few are pastured. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The fluctuating water table is moderately high in the spring but drops rapidly during the growing season. Tile drainage is beneficial in some areas. The drainage system should be carefully controlled, however, because the soil is somewhat droughty during extended dry periods. Installing the tile is difficult because of the loose, water-bearing sand and gravel. If row crops are intensively grown, erosion is a slight hazard. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

In the areas used as pasture, overstocking or grazing during wet periods can result in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

249—Zwingle silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on high stream benches below limestone bluffs along tributaries of the Mississippi River. Areas are irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 4 inches thick. The subsoil is very firm clay about 38 inches thick. The upper part is dark brown and has brown mottles; the next part is dark brown and brown and has light brown, reddish yellow, and grayish brown mottles; and the lower part is dark reddish gray. The upper part of the substratum is mottled yellowish brown and grayish brown clay. The lower part to a depth of about 60 inches is yellowish brown silty clay loam. In some areas the substratum is stratified silt loam and sandy loam.

Included with this soil in mapping are small areas of soils in slight depressions in the stream benches. These soils have a subsoil that is grayer than that of the Zwingle soil. They make up 2 to 8 percent of the unit.

The Zwingle soil is very slowly permeable in the subsoil and the substratum. It has a seasonal high water table. Available water capacity is moderate or high. Surface runoff is slow. Tilth is poor. The soil puddles easily when wet and cannot be easily worked because of the high content of clay. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is strongly acid in the surface soil and strongly acid or very strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used as permanent pasture. Some are cultivated. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is wet and sticky and has a high content of clay. Also, fertility is low. Tile cannot drain the soil satisfactorily. A surface drainage system helps to remove excess water. Regularly adding organic material improves fertility.

Even if well managed, this soil is only moderately productive as pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods are needed.

This soil is poorly suited to trees because of the seasonal high water table. Also, shallow ponding is a hazard in some areas. The equipment limitation is severe, and seedling mortality and the windthrow hazard are moderate. Operating logging equipment is difficult. Ordinary logging equipment should be used only during the drier periods or during the winter, when the ground is frozen. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIw.

249C—Zwingle silt loam, 2 to 9 percent slopes. This gently sloping and moderately sloping, poorly drained soil is on high stream benches below limestone bluffs along tributaries of the Mississippi River. Areas are irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 4 inches thick. The subsurface layer is grayish brown silt loam about 4 inches thick. The subsoil is very firm clay about 35 inches thick. The upper part is dark brown and has reddish brown mottles; the next part is dark brown and has dark reddish gray and grayish brown mottles; and the lower part is dark brown. The substratum to a depth of about 60 inches is brown and reddish brown silt loam. In some areas the surface layer is grayish brown silt loam. In other areas the substratum is stratified silt loam and sandy loam.

This soil is very slowly permeable in the subsoil and the substratum. It has a seasonal high water table. Available water capacity is moderate or high. Surface runoff is slow or medium. Tilth is poor. The soil puddles easily when wet and cannot be easily worked. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is strongly acid in the surface soil and strongly acid or very strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used as permanent pasture. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is wet and sticky and has a high content of clay. Also, erosion is a hazard if cultivated crops are grown. The soil is poorly suited to terracing because of the clayey subsoil. Tile cannot drain the soil satisfactorily. Regularly adding organic material improves fertility.

If it can be established, a cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods are needed.

This soil is poorly suited to trees because it has a seasonal high water table. Also, shallow ponding is a hazard in some areas. The equipment limitation is severe, and seedling mortality and the windthrow hazard are moderate. Operating logging equipment is difficult. Ordinary logging equipment should be used only during the drier periods or during the winter, when the ground is frozen. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by adequate site preparation or by spraying or cutting.

The capability subclass is IIIe.

284—Flagler sandy loam, 0 to 2 percent slopes. This nearly level, somewhat excessively drained soil is on benches along small rivers and streams. Areas are irregularly shaped and are 5 to 15 acres in size.

Typically, the surface layer is very dark brown sandy loam about 10 inches thick. The subsurface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is very friable sandy loam about 14 inches thick. The upper part is brown, and the lower part is dark yellowish brown. The content of gravel is about 5 to 10 percent in the lower part. The substratum to a depth of about 60 inches is yellowish brown gravelly sand. In some areas the surface layer is loamy sand.

Included with this soil in mapping are a few small areas where the surface layer is thinner and lighter colored and fertility and the content of organic matter are lower. These areas are on benches near the uplands. They make up less than 5 percent of the unit.

Permeability is moderately rapid in the upper part of the Flagler soil and very rapid in the substratum. Available water capacity is low. Surface runoff is slow. Tilth is good. The soil warms up quickly in the spring and can be worked soon after rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. A few are used as permanent pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is droughty, however, and is subject to soil blowing. A system of conservation tillage that leaves crop residue on the surface conserves moisture and helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

In the areas used as pasture, overgrazing causes surface compaction and increases the likelihood of puddling. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIs.

284B—Flagler sandy loam, 2 to 5 percent slopes. This gently sloping, somewhat excessively drained soil is on benches along small rivers and streams. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown sandy loam about 6 inches thick. The subsoil is about 13 inches thick. It is very friable. The upper part is brown sandy loam, the next part is dark yellowish brown sandy loam, and the lower part is yellowish brown coarse loamy sand. The substratum to a depth of about 60 inches is yellowish brown coarse sand that contains some gravel. In some areas the surface layer is very dark grayish brown sandy loam.

Included with this soil in mapping are a few small areas where the surface layer is thinner and lighter colored and fertility and the content of organic matter are lower. These areas are on the benches near the uplands. They make up less than 5 percent of the unit.

Permeability is moderately rapid in the upper part of the Flagler soil and very rapid in the substratum. Available water capacity is low. Surface runoff is medium. Tilth is good. The soil warms up quickly in the spring and can be worked soon after rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and medium acid or

strongly acid in the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are used as permanent pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is subject to soil blowing and water erosion, however, if it is cultivated. Also, it is droughty in most years. Productivity is low unless rainfall is above normal and very timely. Measures that control runoff, help to prevent excessive soil loss, and conserve moisture are needed. An example is a system of conservation tillage that leaves crop residue on the surface. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control soil blowing and water erosion. Overgrazing, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

291—Atterberry silt loam, 1 to 3 percent slopes. This very gently sloping, somewhat poorly drained soil is on broad ridgetops or divides in the uplands. Areas are irregularly shaped and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown, friable silt loam about 4 inches thick. The subsoil is about 34 inches thick. It is friable. The upper part is brown silt loam mottled with grayish brown and strong brown; the next part is grayish brown silty clay loam mottled with strong brown; and the lower part is grayish brown silt loam mottled with strong brown. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown silt loam.

Included with this soil in mapping are areas where the surface layer is thinner and lighter colored and fertility and the content of organic matter are lower and small areas where the surface layer is thicker and darker and fertility and the content of organic matter are higher. These areas are on the ridgetops. The lighter colored areas make up less than 5 percent of the unit. The darker areas also make up less than 5 percent of the unit. Also included are a few small areas of poorly drained soils on the lower lying parts of the ridgetops. The wetness in these areas delays fieldwork for several days during wet periods unless tile drains are installed. These poorly drained soils make up less than 2 percent of the unit.

The Atterberry soil is moderately permeable. It has a seasonal high water table. Available water capacity is high or very high. Surface runoff is slow. Tilth is good, but the soil tends to crust after heavy rainfall. The crusting retards plant growth. The content of organic matter is about 2 to 4 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface soil and strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain. The seasonal high water table often delays fieldwork in spring and during other wet periods. Installing drainage tile improves the timeliness of fieldwork. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth.

This soil is well suited to grasses and legumes for pasture or hay. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. It has a seasonal high water table, however, and remains wet for moderate periods after rainfall. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability class is I.

320—Arenzville silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained and well drained soil is on narrow bottom land and alluvial fans below more sloping soils on loess-covered uplands. It is subject to flooding. Areas are elongated and range from 5 to 25 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The substratum is stratified dark grayish brown, brown, very dark grayish brown, and grayish brown silt loam about 21 inches thick. Below this is an older buried surface layer of black silt loam about 17 inches thick. The underlying material to a depth of about 60 inches is very dark grayish brown loam. In some areas the surface layer is dark brown and dark grayish brown silt loam.

Included with this soil in mapping are areas where the stratified silty sediments are more than 40 inches thick because siltation is more extensive or more frequent. These areas are near streams. They make up less than 10 percent of the unit.

The Arenzville soil is moderately permeable. It has a seasonal high water table. Available water capacity is high or very high. Surface runoff is slow. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is 0.5 to 1.0 percent in the surface layer. Reaction typically is neutral or slightly acid throughout the profile. The supply of available

phosphorus generally is low, and the supply of available potassium is very low.

Many areas are cultivated. Some narrow areas are used as permanent pasture. This soil is suited to corn, soybeans, and small grain. It is susceptible to high velocity, short duration flooding, however, during periods of heavy rainfall. The floodwater damages crops in some years. It can be controlled by levees and dikes.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing or grazing during wet periods after flooding, however, causes surface compaction and increases the likelihood of puddling. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees, but it is subject to overflow and to siltation from the more sloping adjacent upland soils. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIw.

323B—Terril loam, sandy substratum, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on foot slopes and alluvial fans. Areas are about 5 to 15 acres in size and generally are long and narrow.

Typically, the surface layer is black loam about 14 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 13 inches thick. The subsoil is friable loam about 22 inches thick. The upper part is brown, the next part is yellowish brown, and the lower part is dark yellowish brown. The substratum to a depth of about 60 inches is yellowish brown loamy sand. In some areas the surface soil is less than 24 inches thick.

Included with this soil in mapping are a few areas of somewhat poorly drained soils that have a dark grayish brown subsoil. The wetness in these areas delays fieldwork in the spring of some years. These soils are on concave foot slopes. They make up less than 5 percent of the unit.

Permeability is moderate in the upper part of the Terril soil and rapid in the substratum. Available water capacity is high. Surface runoff is medium in cultivated areas. Tilth is good. The content of organic matter is about 4 to 5 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface soil and subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Because this soil generally occurs as long and narrow areas, the use tends to be determined by the use of the adjacent soils. Many areas are cultivated along with the bottom land downslope. Some are used as permanent pasture along with the steeper soils upslope. The soil is well suited to corn, soybeans, and small grain. Because it receives runoff from the steeper soils upslope, however, it is subject to rill erosion and gullying. Diversion terraces help to control the runoff. Reshaping and seeding waterways help to prevent gullying.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

391B—Clyde-Floyd complex, 1 to 4 percent slopes. These nearly level to gently sloping soils are along narrow upland drainageways that are U-shaped and generally are about 200 to 450 feet wide. The poorly drained Clyde soil is in the drainageways, and the somewhat poorly drained Floyd soil is adjacent to the drainageways, at the base of upland slopes. Areas are 40 to 200 acres or more in size. They are about 50 percent Clyde soil and 35 percent Floyd soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Clyde soil has a surface layer of black clay loam about 9 inches thick. The subsurface layer is about 14 inches of very dark gray clay loam and silty clay loam. The subsoil is about 20 inches thick. The upper part is mottled gray, light olive brown, and dark gray, friable silty clay loam; the next part is mottled gray and strong brown, friable sandy loam; and the lower part is mottled yellowish brown and grayish brown, firm loam. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown loam.

Typically, the Floyd soil has a surface layer of black loam about 7 inches thick. The subsurface layer is black loam about 8 inches thick. The subsoil is about 34 inches thick. The upper part is dark grayish brown, friable loam; the next part is mottled grayish brown, yellowish brown, and strong brown, friable and very friable loam, sandy loam, and loamy sand; and the lower part is strong brown, firm loam mottled with grayish brown. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown loam.

Included with these soils in mapping are small areas where the surface layer is sandy or mucky. These areas are in the drainageways. The sandy soils are lower in fertility and less productive than the Clyde and Floyd soils. The mucky soils cannot be drained easily. The wetness may delay fieldwork. Included soils make up about 15 percent of the unit.

The Clyde and Floyd soils are moderately permeable. They have a seasonal high water table. Available water capacity is high. Surface runoff is slow. Tilth is fair. The soils puddle readily if worked when wet and are hard and cloddy when dry. The content of organic matter is about 7 to 11 percent in the surface layer of the Clyde soil and about 5 to 7 percent in the surface layer of the Floyd soil. Reaction typically is neutral or slightly acid in the

surface soil and subsoil of both soils. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Most areas that have not been tile drained are used as permanent pasture. If drained, these soils are well suited to corn, soybeans, and small grain. They are wet because of hillside seepage and runoff from adjacent soils upslope. Because of the seepage, a drainage system that intercepts laterally moving water is most likely to be successful. Stones and large granite boulders, which are common in many areas, may hinder the installation of tile. They should be removed before crops are grown. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth.

These soils are well suited to grasses and legumes for pasture or hay. Overgrazing or grazing during wet periods, however, causes surface compaction and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soils in good condition.

The capability subclass is IIw.

408B—Olin fine sandy loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and side slopes on glaciated uplands. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown fine sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown and dark brown fine sandy loam about 12 inches thick. The subsoil is about 34 inches thick. The upper part is brown, very friable sandy loam; the next part is yellowish brown, friable loam; and the lower part is yellowish brown, firm loam mottled with strong brown and brown. The substratum to a depth of about 60 inches is yellowish brown loam mottled with brown. In some areas the surface layer is loamy sand. In other areas the depth to loam glacial till is more than 40 inches.

Permeability is moderately rapid in the surface soil and the upper part of the subsoil and moderate in the glacial till in the lower part of the subsoil and in the substratum. Available water capacity is high. Surface runoff is medium in cultivated areas. Tilth is good. The soil can be worked easily and dries out quickly in the spring. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface soil and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is subject to soil blowing and water erosion, however, if it is cultivated, and it is droughty in some years. Because the soil is moderately rapidly permeable in the upper part and moderately permeable in the lower part, seepage is a problem in some areas. It occurs during periods of heavy rainfall, when water tends to accumulate and then moves laterally. It can be controlled by tile drains. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The soil is not well suited to terracing because of the fine sandy loam surface layer.

A cover of pasture plants or hay helps to control soil blowing and water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

408C—Olin fine sandy loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex side slopes on glaciated uplands. Areas are about 5 to 10 acres in size and are elongated.

Typically, the surface layer is very dark brown fine sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 32 inches thick. The upper part is brown, very friable sandy loam; the next part is yellowish brown, firm loam mottled with grayish brown and brown; and the lower part is yellowish brown, firm loam mottled with grayish brown. The substratum to a depth of about 60 inches is yellowish brown loam mottled with grayish brown. In some areas the surface layer and subsurface layer are loamy sand.

Included with this soil in mapping are a few areas where the surface soil is less than 10 inches thick and fertility and the content of organic matter are lower. These areas are on the higher parts of the side slopes. They make up less than 6 percent of the unit.

Permeability is moderately rapid in the surface soil and the upper part of the subsoil and moderate in the glacial till in the lower part of the subsoil and in the substratum. Available water capacity is high. Surface runoff is medium or rapid in cultivated areas. Tilth is good. The soil can be worked easily and dries out quickly in the spring. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface soil and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. A few are pastured. If well managed, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is subject to soil blowing and water erosion, however, if it is cultivated, and it is droughty in some years. Because the soil is moderately rapidly permeable in the upper part and moderately permeable in the lower part, seepage is a problem. It occurs during periods of heavy rainfall,

when water tends to accumulate and then moves laterally. It can be controlled by tile drains. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The soil is not well suited to terracing because of the fine sandy loam surface layer. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control soil blowing and water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

444B—Jacwin loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on foot slopes on high benches below areas where limestone crops out. Areas are irregularly shaped and range from 15 to 40 acres in size.

Typically, the surface layer is black loam about 13 inches thick. The subsurface layer is very dark grayish brown loam about 5 inches thick. The subsoil is about 17 inches thick. The upper part is dark grayish brown, friable loam mottled with yellowish brown and light olive brown, and the lower part is greenish gray and yellowish brown, extremely firm silty clay. Greenish gray and yellowish brown silty clay shale is at a depth of about 35 inches. In some areas the surface layer is sandy loam.

Included with this soil in mapping are areas where the depth to clayey shale is 4 feet or more and a sandy layer as much as 2 feet thick is common. These areas generally cannot be drained easily. They are on the upper parts of the foot slopes. They make up 5 to 10 percent of the unit.

The Jacwin soil is moderately permeable in the upper part and very slowly permeable in the lower part. It has a seasonal high water table. Available water capacity is moderate. Surface runoff is medium. Tilth is fair. The soil dries out slowly and tends to puddle if worked when wet. The content of organic matter is about 4 to 5 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface soil and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used as permanent pasture. If drained and protected against water erosion, this soil is suited to corn and soybeans. Draining the soil is difficult because the wetness is caused by runoff from the soils upslope. The excess water should be intercepted before it seeps into the root zone of those soils. Also, tile drains should not be installed in the clayey shale, and the backfill material should be porous. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. A combination of drainage tile and terraces is needed in some areas.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

The capability subclass is IIe.

444C—Jacwin loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained soil is on slightly concave foot slopes on high benches in the uplands. Areas are irregularly shaped and are 5 to 15 acres in size.

Typically, the surface layer is black loam about 11 inches thick. The subsurface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 16 inches thick. The upper part is dark grayish brown, friable loam that has a few light olive brown mottles, and the lower part is greenish gray and yellowish brown, extremely firm silty clay. Greenish gray and yellowish brown silty clay shale is at a depth of about 35 inches. In some areas the surface layer is very dark grayish brown sandy loam about 6 inches thick.

Included with this soil in mapping are areas where the depth to clayey shale is 4 feet or more and a sandy layer as much as 2 feet thick is common. These areas generally cannot be drained easily. They are on the upper parts of the foot slopes. They make up 5 to 10 percent of the unit.

The Jacwin soil is moderately permeable in the upper part and very slowly permeable in the lower part. It has a seasonal high water table. Available water capacity is moderate. Surface runoff is medium. Tilth is fair. The soil is wet and seepy in the spring. It dries out slowly and tends to puddle if it is worked when wet. The content of organic matter is about 4 to 5 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface soil and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used as permanent pasture. This soil is suited to corn, soybeans, and small grain. It is subject to erosion, however, if it is cultivated. Also, it is wet and seepy. Draining the soil is difficult because the wetness is caused by runoff from the soils upslope. The excess water should be intercepted before it seeps into the root zone of those soils. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. A combination of terraces and drainage tile is needed in some areas.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use

during wet periods help to keep the pasture and the soil in fairly good condition.

The capability subclass is IIIe.

444D—Jacwin loam, 9 to 14 percent slopes. This strongly sloping, somewhat poorly drained soil is on slightly convex foot slopes and side slopes on high benches in the uplands. Areas are irregularly shaped and are 5 to 10 acres in size.

Typically, the surface layer is black loam about 10 inches thick. The subsurface layer is very dark grayish brown loam about 5 inches thick. The subsoil is about 15 inches thick. The upper part is dark grayish brown, friable loam that has a few light olive brown mottles, and the lower part is greenish gray and yellowish brown, extremely firm silty clay. Greenish gray and yellowish brown silty clay shale is at a depth of about 30 inches. In some areas the surface layer is dark grayish brown loam about 6 inches thick.

Included with this soil in mapping are a few areas where the depth to clayey shale is 4 feet or more and a sandy layer as much as 2 feet thick is common. These areas generally cannot be drained easily. They are on the upper parts of the foot slopes. They make up less than 6 percent of the unit. Also included are a few areas, on the lower parts of the side slopes, where the depth to clayey shale is less than 20 inches. The soils in these areas are better drained than the Jacwin soil. Also, they have a higher content of lime in the surface layer. They make up less than 4 percent of the unit.

The Jacwin soil is moderately permeable in the upper part and very slowly permeable in the lower part. It has a seasonal high water table. Available water capacity is moderate. Surface runoff is rapid. Tilth is fair. The soil tends to puddle if worked when wet. The content of organic matter is about 4 to 5 percent in the surface layer. Reaction typically is neutral in the surface soil and the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used as permanent pasture. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. Also, wetness and seepage are limitations. Draining the soil is difficult because the wetness is caused by runoff from the soils upslope. The excess water should be intercepted before it seeps into the root zone of those soils.

A cover of pasture plants helps to control erosion, but grazing should be limited because the maximum stocking rate on this soil is low. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

462B—Downs silt loam, benches, 2 to 5 percent slopes. This gently sloping, well drained soil is on high loess-covered benches along small streams. Areas are irregularly shaped and range from 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is friable silt loam about 36 inches thick. The upper part is brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown silt loam that has a few grayish brown mottles. Coarse sand and gravel are below a depth of 60 inches. In some areas the surface layer is very dark brown silt loam about 10 inches thick.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is medium in cultivated areas. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and stripcropping help to prevent excessive soil loss. In a few areas slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIe.

463B—Fayette silt loam, benches, 2 to 5 percent slopes. This gently sloping, well drained soil is on high loess-covered benches along small streams. Areas are irregularly shaped and range from 10 to 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 37 inches thick. It is friable. The upper part is brown silty clay loam, the next part is dark yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam. Coarse sand and gravel are

below a depth of about 60 inches. In some areas the surface layer is dark grayish brown and brown silt loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is medium in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and stripcropping help to prevent excessive soil loss. In a few areas slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIe.

463C—Fayette silt loam, benches, 5 to 9 percent slopes. This moderately sloping, well drained soil is on high benches along small streams. Areas are irregularly shaped and range from 10 to 30 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 37 inches thick. It is friable. The upper part is brown silty clay loam, the next part is dark yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam. Coarse sand and gravel are below a depth of 60 inches. In some areas the surface layer is dark grayish brown and brown silt loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is medium in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and stripcropping help to prevent excessive soil loss. In a few areas slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

471—Oran loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on broad upland ridges. Areas are about 20 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loam about 8 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is about 28 inches thick. The upper part is grayish brown, friable loam mottled with yellowish brown and reddish brown; the next part is mottled grayish brown, strong brown, and light brownish gray, firm loam; and the lower part is mottled grayish brown and strong brown, firm loam. The substratum to a depth of about 60 inches is mottled light brownish gray and strong brown loam. In most areas it is underlain by limestone bedrock at a depth of 6 to 10 feet. In some areas the surface layer is dark grayish brown silt loam.

This soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow in cultivated areas. Tilth is good. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and medium acid or strongly acid in the subsurface layer and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain. In places it is too wet for planting early in spring because the water table is seasonally high. Tile drainage is beneficial in some years. It improves the timeliness of fieldwork. A system

of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent deterioration of tilth.

This soil is well suited to grasses and legumes for pasture or hay. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. It has a seasonal high water table, however, and remains wet for moderate periods after rainfall. Equipment should be used only during the drier periods. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by careful site preparation or by spraying or cutting.

The capability class is I.

478G—Rock outcrop-Nordness complex, 25 to 60 percent slopes. This very steep map unit occurs as areas of Rock outcrop intermingled with areas of a shallow, well drained Nordness soil. It is on escarpments and upland slopes along the major streams (fig. 15). The escarpments commonly are 100 to 200 feet high, but in some areas they rise nearly 400 feet above the Mississippi River. The precipitous slopes commonly are wooded and covered by huge masses and blocks of limestone broken off from the higher lying adjacent

Figure 15.—An area of Rock outcrop-Nordness complex, 25 to 60 percent slopes, south of McGregor.

slopes. Areas are about 45 percent Rock outcrop and 40 percent Nordness soil. The soil and the Rock outcrop occur as areas so intricately mixed that mapping them separately is not practical.

Included with the Rock outcrop and Nordness soil in mapping are areas of the moderately deep or deep Dubuque and Jacwin soils on the upper parts of the slopes. These soils make up about 5 percent of the unit. Also included are areas of Nordness soils that have a slope of more than 60 percent. These soils make up about 10 percent of the unit.

Typically, the Rock outcrop is dolomite limestone bedrock. Near the Mississippi River, however, it also occurs as beds of sandstone and shale. A thin layer of silt loam or loam covers the bedrock in some areas.

Typically, the Nordness soil has a surface layer of very dark gray silt loam about 1 inch thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is about 5 inches thick. The upper part is brown, friable silt loam, and the lower part is dark brown, very firm silty clay. Hard, fractured limestone is at a depth of about 8 inches. Limestone fragments are common on the surface and throughout the soil.

Permeability is moderate in the Nordness soil. Available water capacity is very low. Surface runoff is very rapid. Tilth is poor. The content of organic matter is about 1 to 2 percent in the surface layer. The soil typically is neutral or slightly acid throughout. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are wooded. A few areas are used as permanent pasture. This map unit is not suited to cultivated crops or to hay and pasture because of the very steep slope and the Rock outcrop.

This map unit is poorly suited to trees. Seedling mortality is severe on the Nordness soil because of the very steep slope and the shallowness to limestone bedrock. The limestone is fractured, however, and tree roots can penetrate the rock crevasses. Plant competition should be controlled by careful site preparation or by spraying or cutting. Ordinary equipment cannot be used because of the very steep slope. Special equipment can be used, but caution is needed in operating this equipment.

The capability subclass is VIIs.

480B—Orwood silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on narrow ridges in the uplands. Areas are about 10 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 48 inches thick. It is friable. The upper part is brown and yellowish brown silt loam high in content of sand, the next part is yellowish brown loam, and the lower part is yellowish brown loam that has lenses of strong brown fine sand. The substratum to a depth of 60 inches is yellowish brown loam that has lenses of yellowish brown fine sand. In some areas the surface layer is loam.

Included with this soil in mapping are areas where the surface layer is lighter colored and the content of organic matter is lower. These areas are on the ridges. They make up less than 10 percent of the unit.

Permeability is moderate in the Orwood soil. Available water capacity is high or very high. Surface runoff is medium in cultivated areas. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. In some areas slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIe.

480C—Orwood silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow ridges and long, convex side slopes in the uplands. Areas are about 10 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is about 8 inches of very dark grayish brown silt loam high in content of sand. The subsoil is about 40 inches thick. It is friable. The upper part is brown silt loam high in content of sand, the next part is dark yellowish brown silt loam high in content of sand, and the lower part is yellowish brown loam. The substratum to a depth of about 60 inches is yellowish brown loam that has lenses of strong brown fine sand. In some areas the surface layer is loam. In other areas it is dark grayish brown silt loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is medium in cultivated

areas. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. In some areas slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

480D2—Orwood silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on long, convex side slopes in the uplands. Areas are elongated and are 10 to 15 acres in size.

Typically, the surface layer is about 8 inches of mixed very dark grayish brown and brown silt loam high in content of sand. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 35 inches thick. It is friable. The upper part is brown silt loam high in content of sand, the next part is dark yellowish brown silt loam high in content of sand, and the lower part is yellowish brown loam. The substratum to a depth of about 60 inches is yellowish brown loam that has lenses of strong brown fine sand.

Included with this soil in mapping are small, severely eroded areas where the surface layer is brown silt loam and fertility and the content of organic matter are lower. These areas are on the higher parts of the side slopes. They make up less than 5 percent of the unit.

Permeability is moderate in the Orwood soil. Available water capacity is high or very high. Surface runoff is rapid in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans grown occasionally in rotation with small grain and to grasses and legumes for hay and pasture. Further erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. In many areas slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

480E2—Orwood silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on short, convex side slopes in the uplands. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is about 8 inches of mixed very dark grayish brown and brown silt loam high in content of sand. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 32 inches thick. It is friable. The upper part is brown silt loam high in content of sand, the next part is dark yellowish brown silt loam high in content of sand, and the lower part is yellowish brown loam. The substratum to a depth of about 60 inches is yellowish brown loam and fine sand.

Included with this soil in mapping are small, severely eroded areas where the surface layer is brown silt loam and fertility and the content of organic matter are lower. These areas are on the higher parts of the side slopes. They make up less than 8 percent of the unit.

Permeability is moderate in the Orwood soil. Available water capacity is high or very high. Surface runoff is rapid in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil

generally has a medium supply of available phosphorus and a low supply of available potassium.

Many areas are cultivated. Some are pastured. This soil is poorly suited to corn and soybeans. Further erosion is a hazard if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. In most areas slopes are too short and too steep for terracing, but some areas can be terraced along with the less sloping soils upslope. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating the equipment.

The capability subclass is IVe.

483C—Frankville silt loam, 20 to 30 inches to limestone, 5 to 9 percent slopes. This moderately sloping, well drained soil is on long, narrow ridges in the uplands. Areas are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is brown and dark yellowish brown, friable silt loam; the next part is yellowish brown, friable silty clay loam; and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 28 inches.

Permeability is moderate. Available water capacity is low. Surface runoff is medium or rapid in cultivated areas. Tilth is good. The soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are pastured. This soil is suited to cultivated crops occasionally grown in rotation with hay and small grain. Erosion is a hazard, however, if cultivated crops are grown. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone. A scarcity of moisture is likely to result in crop damage unless rainfall is timely during the growing season. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. The soil is not well suited to terracing because the bedrock may interfere with construction. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Tree growth may be limited, however, because of the low available water capacity and the shallowness to limestone bedrock. Seedlings survive and grow well only if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

483D2—Frankville silt loam, 20 to 30 inches to limestone, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex side slopes in the uplands. Areas are about 5 to 15 acres in size and are elongated.

Typically, the surface layer is mixed very dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 20 inches thick. The upper part is brown, friable silt loam; the next part is yellowish brown, friable silty clay loam; and the lower part is brown, very firm silty clay. Hard, fractured limestone bedrock is at a depth of about 28 inches. In some areas the surface layer is brown silty clay loam.

Included with this soil in mapping are small areas where the depth to limestone bedrock is 30 to 40 inches and the soil is less droughty. These areas are on the upper parts of the side slopes. They make up less than 5 percent of the unit.

Permeability is moderate in the Frankville soil. Available water capacity is low. Surface runoff is rapid in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are pastured. This soil is poorly suited to cultivated crops because the hazard of further erosion is severe. Soil loss through erosion adversely affects cropping by decreasing the

depth to limestone. A scarcity of moisture is likely to result in crop damage unless rainfall is timely during the growing season. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss. The soil is not well suited to terracing because deep cuts may expose the limestone bedrock. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Tree growth may be limited, however, because of the low available water capacity and the shallowness to limestone bedrock. Seedlings survive and grow well only if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVe.

483E2—Frankville silt loam, 20 to 30 inches to limestone, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on short, convex side slopes in the uplands. Areas are elongated and are 5 to 15 acres in size.

Typically, the surface layer is mixed very dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 14 inches thick. The upper part is brown and dark yellowish brown, friable silt loam; the next part is yellowish brown, friable silty clay loam; and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 22 inches. In some areas the surface layer is brown silty clay loam.

Included with this soil in mapping are small areas of Nordness soils on the lower parts of the side slopes. These soils are 8 to 20 inches deep over limestone bedrock and are more droughty than the Frankville soil. They make up about 2 to 8 percent of the unit.

Permeability is moderate in the Frankville soil. Available water capacity is low. Surface runoff is rapid. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are pastured. Some are cultivated. This soil generally is not suited to corn and soybeans and is poorly suited to small grain and hay. If cultivated crops are grown, the hazard of further erosion is severe. These crops should be grown only to reestablish pasture. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is moderately well suited to trees. Tree growth may be limited by the low available water capacity and the shallowness to limestone bedrock. The hazard of erosion and the equipment limitation are severe. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment is needed. Also, caution is needed in operating the equipment.

The capability subclass is VIe.

485—Spillville loam, 0 to 2 percent slopes. This nearly level, moderately well drained and somewhat poorly drained soil is on bottom land along small rivers and large streams. It is subject to flooding. Areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is black loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 41 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown sandy loam mottled with very dark gray. In some areas the surface soil is only about 24 to 30 inches thick.

Included with this soil in mapping are small areas that have received 6 to 18 inches of lighter colored silt loam overwash. Also included are small areas of sandy soils that are lower in content of organic matter and less fertile than the Spillville soil. Included areas are near the streams. They make up 5 to 10 percent of the unit.

The Spillville soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow. Tilth is good. The content of organic matter is about 4 to 6 percent in the surface layer. The soil typically is neutral or slightly acid throughout. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. A few are used as permanent pasture. If protected from floodwater, this soil is well suited to corn, soybeans, and small grain. Diversion terraces are needed in some areas to control the floodwater. The need for flood protection varies from area to area because the flooding pattern was modified

when streams channels were deepened and straightened and when roads and road ditches were contructed.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability class is I.

487B—Otter-Worthen silt loams, 1 to 4 percent slopes. These gently sloping soils are along narrow drainageways at the base of upland slopes. The drainageways are U-shaped and generally are about 150 to 300 feet wide. The poorly drained Otter soil is in the drainageways and is subject to flooding. The well drained Worthen soil is in the higher lying areas adjacent to the drainageways. Areas are long and narrow and commonly are several hundred acres in size. They are about 55 percent Otter soil and 35 percent Worthen soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Otter soil has a surface layer of very dark gray silt loam about 8 inches thick. The subsurface layer is black and very dark gray silt loam about 23 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is friable silt loam. The upper part is dark gray and is mottled with light olive brown, and the lower part is mottled grayish brown and light olive brown. In some areas the surface layer is silty clay loam.

Typically, the Worthen soil has a surface layer of very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown and dark grayish brown silt loam about 24 inches thick. The subsoil is friable silt loam about 20 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown silt loam that has a few grayish brown mottles.

Included with these soils in mapping, along the lower parts of the drainageways, are small areas that have received 6 to 18 inches of lighter colored silt loam overwash. The soils in these areas are less fertile than the Otter and Worthen soils and have a lower content of organic matter. They make up about 10 percent of the unit.

Permeability is moderate in the Otter and Worthen soils. The Otter soil has a seasonal high water table. Available water capacity is high or very high in the Otter soil and very high in the Worthen soil. Surface runoff is slow on both soils. Tilth is fair in the Otter soil and good in the Worthen soil. The Otter soil puddles readily if worked when wet and is hard and cloddy when dry. The content of organic matter is about 5 to 7 percent in the surface layer of the Otter soil and 3 to 5 percent in the surface layer of the Worthen soil. Reaction typically is neutral or slightly acid in the upper part of both soils. It is neutral in the substratum of the Otter soil and medium acid in the subsoil of the Worthen soil. The substratum of the Otter soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Worthen soil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are used as permanent pasture. Some are cropped along with the surrounding soils. They generally are too small to be cropped separately. If drained and protected from floodwater, the Otter soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The Worthen soil is well suited to those uses. During periods of heavy rainfall, the wet Otter soil is subject to overflow from the more sloping soils upslope and the Worthen soil receives runoff from those soils. As a result, crops are damaged in some years. Diversion terraces are needed in some areas to prevent crop damage. Tile drains function well in most areas if suitable outlets are available. If the Worthen soil is cultivated, erosion is a slight hazard. It can be controlled, however, by a system of conservation tillage that leaves crop residue on the surface.

In the areas used as pasture, overgrazing or grazing during wet periods increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The Otter soil is poorly suited to trees because it is subject to overflow and may remain wet for moderate to long periods after rainfall. The equipment limitation is severe, and seedling mortality and the windthrow hazard are moderate. Ordinary logging equipment should be used only during the drier periods or during the winter, when the ground is frozen. Because they do not survive well, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees.

The capability subclass is IIw.

489—Ossian silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land, low stream benches, and the lower parts of broad upland drainageways. It is subject to flooding. Areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is very dark gray silt loam about 6 inches thick. The subsurface layer is black and very dark gray silt loam about 23 inches thick. The subsoil is friable silt loam about 34 inches thick. The upper part is dark gray and is mottled with grayish brown, the next part is olive gray and is mottled with light olive brown, olive yellow, and yellowish brown, and the lower part is olive gray. The substratum to a depth of about 60 inches is olive gray silt loam mottled with strong brown. In some areas the surface layer and

subsurface layer are silty clay loam. In other areas the surface layer is dark grayish brown silt loam.

This soil is moderately permeable. It has a seasonal high water table. Available water capacity is very high. Surface runoff is very slow. Tilth is fair. The soil puddles readily if worked when wet and is hard and cloddy when dry. The content of organic matter is about 5 to 7 percent in the surface layer. The soil typically is neutral throughout. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. A few are pastured. If drained and protected from floodwater, this soil is well suited to corn and soybeans. It is wet as a result of the occasional flooding, the slow runoff, and the seasonal high water table. Plowing is difficult, and tillage is delayed in some years because of excessive wetness. Tile drains function well if suitable outlets are available. Diversion terraces help to control floodwater.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing during wet periods, however, increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

490—Caneek silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained and poorly drained soil is on narrow bottom land below very steep limestone bluffs and escarpments. It is subject to flooding. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The substratum is stratified dark grayish brown, dark gray, brown, and very dark grayish brown silt loam about 26 inches thick. It has common reddish brown mottles. The next 18 inches is an older buried surface layer of black and very dark gray, friable silt loam. Below this to a depth of about 60 inches is a buried subsoil of dark gray silt loam.

Included with this soil in mapping are areas where the stratified silty sediments are more than 40 inches thick because siltation is more frequent or more extensive. These areas are near the streams. They make up about 5 to 10 percent of the unit.

The Caneek soil is moderately permeable. It has a seasonal high water table. Available water capacity is very high. Surface runoff is slow. Tilth is poor. The soil dries out slowly and tends to puddle or crust after heavy rainfall. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is mildly alkaline in the silty sediments and neutral in the buried surface layer. The supply of available phosphorus and potassium generally is very low.

Most areas are used for permanent pasture or are wooded. A few are cultivated. If drained and protected from floodwater, this soil is suited to corn, soybeans, and small grain. It is wet as a result of the flooding, the slow runoff, and the seasonal high water table. In some years crops are damaged by high velocity runoff during periods of heavy rainfall. Tile drains function well if suitable outlets are available. Diversion terraces help to control floodwater.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing or grazing during wet periods, however, causes surface compaction and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

496B—Dorchester-Volney complex, 1 to 5 percent slopes. These gently sloping soils are on the lower parts of narrow upland drainageways. They are subject to flooding. The Dorchester soil is moderately well drained and the Volney soil well drained or somewhat excessively drained. The drainageways generally are 200 to 500 feet wide and are as long as 2 miles or more. They are dry most of the year but become high velocity streams for short periods during heavy rainfall. Areas are about 50 percent Dorchester soil and 40 percent Volney soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Dorchester soil is dark grayish brown silt loam about 8 inches thick. The substratum is stratified dark grayish brown, grayish brown, and brown silt loam about 23 inches thick. Below this to a depth of about 60 inches is an older buried surface layer of black and very dark brown silt loam. In some areas the surface layer is very dark grayish brown silt loam.

Typically, the surface layer of the Volney soil is very dark brown channery silt loam about 11 inches thick. The subsurface layer is black and very dark brown channery silt loam about 18 inches thick. The content of coarse limestone fragments in this layer is about 40 to 60 percent. The substratum to a depth of about 60 inches is very dark brown, very dark grayish brown, and brown very flaggy silt loam. In some areas it is very channery loam.

Included with these soils in mapping are small areas of the somewhat poorly drained and poorly drained Caneek soils. These included soils are in low lying areas and are wet because of seepage from the soils upslope. They make up about 10 percent of the unit.

Permeability is moderate in the Dorchester soil. It is moderately rapid in the upper part of the Volney soil and very rapid in the substratum. Available water capacity is very high in the Dorchester soil and moderate in the Volney soil. Surface runoff is medium on both soils. Tilth is fair in the Dorchester soil and poor in the Volney soil. If cultivated, the Dorchester soil tends to puddle or crust after heavy rainfall. Because of the coarse limestone

fragments, cultivating the Volney soil is very difficult. The content of organic matter is about 0.5 to 1.0 percent in the surface layer of the Dorchester soil and 3 to 5 percent in the surface layer of the Volney soil. The surface layer of both soils is mildly alkaline or moderately alkaline. The supply of available phosphorus is low and the supply of available potassium very low.

Most areas are used as permanent pasture or are wooded. These soils generally are not suited to cultivated crops or to grasses and legumes for hay. They are subject to occasional high velocity runoff from the steep and very steep soils upslope. Young crops can be covered by the sediments. In some areas the runoff deposits new sediments containing limestone fragments, which interfere with fieldwork. Because the soils are below areas of the very steep Rock outcrop-Nordness complex, accessing most areas with ordinary farm machinery is very difficult. In some areas diversions help to remove local runoff.

These soils are suited to pasture, but they are subject to high velocity runoff during periods of heavy rainfall and can be covered by sediments. Grazing during wet periods causes surface compaction and excessive runoff. The maximum grazing capacity generally is low because many areas are not readily accessible and little fertilizer can be applied. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to prevent further damage to the pasture and the soil.

These soils are moderately well suited to trees. Seedling mortality is moderate on the Dorchester soil because of the high velocity runoff. Seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by careful site preparation or by spraying or cutting.

The capability subclass is VIs.

497E—Fayette-Dubuque silt loams, 14 to 18 percent slopes. These moderately steep, well drained soils are on generally short upland slopes that are dissected by many small waterways and gullies. The Fayette soil is on convex side slopes, and the Dubuque soil is near the base of the convex slopes. Areas are irregularly shaped and range from 10 to 40 acres in size. They are about 50 percent Fayette soil and 30 percent Dubuque soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Fayette soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is dark gray and dark grayish brown silt loam about 5 inches thick. The subsoil is about 35 inches thick. It is friable. The upper part is dark yellowish brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown.

Typically, the Dubuque soil has a surface layer of very dark grayish brown silt loam about 6 inches thick. The subsoil is about 15 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is yellowish brown, friable silty clay loam; and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 21 inches.

Included with these soils in mapping are small areas of Exette, Jacwin, and Nordness soils. Exette soils are grayer in the subsoil and substratum than the Fayette soil. They are on highly dissected side slopes. The somewhat poorly drained Jacwin soils formed in residuum of clayey shale along waterways and springs. Nordness soils are 8 to 20 inches deep over limestone bedrock. They are at the base of the slopes. Included soils make up about 20 percent of the unit.

Permeability is moderate in the Fayette soil. It is moderate in the upper part of the Dubuque soil and slow in the lower part of the subsoil. Available water capacity is high or very high in the Fayette soil and low in the Dubuque soil. Surface runoff is rapid on both soils. Tilth is fair. If cultivated, the soils tend to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. The Fayette soil typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The Dubuque soil is slightly acid in the surface layer and medium acid in the subsoil. The subsoil of the Fayette soil generally has a high supply of available phosphorus and a very low supply of available potassium. That of the Dubuque soil has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are used as permanent pasture. These soils generally are not suited to cultivated crops or to hay. If cultivated crops are grown, erosion is a severe hazard. Operating farm machinery is difficult because the areas are dissected by many small waterways and gullies. Some areas receive water from small springs and are very wet and seepy. In many areas cultivating is difficult because of limestone boulders on the surface. The boulders have rolled downslope from the higher lying areas.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soils are too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

These soils are moderately well suited to trees. Trees grow well on the Fayette soil, but root penetration is restricted by the limestone bedrock in the Dubuque soil. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or

roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment and caution in operating the equipment are needed.

The capability subclass is VIe.

497F—Fayette-Dubuque silt loams, 18 to 30 percent slopes. These steep and very steep, well drained soils are on generally short upland slopes that are dissected by many small waterways and gullies. The Fayette soil is on convex side slopes, and the Dubuque soil is near the base of the slopes. Areas are irregularly shaped and range from 10 to 45 acres in size. They are about 50 percent Fayette soil and 35 percent Dubuque soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Fayette soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is about 34 inches thick. It is friable. The upper part is dark yellowish brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with grayish brown.

Typically, the Dubuque soil has a surface layer of very dark gray silt loam about 5 inches thick. The subsoil is about 14 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is yellowish brown, friable silty clay loam; and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 20 inches.

Included with these soils in mapping are small areas of Exette, Jacwin, and Nordness soils. Exette soils have a grayer subsoil and substratum than the Fayette soil. They are on highly dissected side slopes. The somewhat poorly drained Jacwin soils formed in residuum of clayey shale along waterways and springs. Nordness soils are 8 to 20 inches deep over limestone bedrock. They are at the base of the slopes. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Fayette soil. It is moderate in the upper part of the Dubuque soil and slow in the lower part of the subsoil. Available water capacity is high or very high in the Fayette soil and low in the Dubuque soil. Surface runoff is rapid on both soils. Tilth is fair. If cultivated, the soils tend to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. The Fayette soil typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The Dubuque soil is slightly acid in the surface layer and medium acid in the subsoil. The subsoil of the Fayette soil generally has a high supply of available phosphorus and a very low supply of available potassium. That of the Dubuque soil has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are used as permanent pasture or are wooded. These soils generally are not suited to cultivated crops or to hay. If cultivated crops are grown, erosion is a severe hazard. Operating farm machinery is difficult because of the slope and the many small waterways and gullies. Some areas receive water from small springs and are very wet and seepy. In many areas cultivating is difficult because of limestone boulders on the surface. The boulders have rolled downslope from the higher lying areas.

These soils are poorly suited to pasture. Grazing should be limited. Overgrazing or grazing when the soils are too wet causes surface compaction and excessive runoff.

These soils are moderately well suited to trees. Trees grow well on the Fayette soil, but root penetration is restricted by the limestone bedrock in the Dubuque soil. The hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment and caution in operating the equipment are needed.

The capability subclass is VIIe.

499B—Nordness silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on extended, narrow ridges in the uplands. Areas are irregularly shaped and are 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 2 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is about 10 inches thick. It has common limestone fragments. The upper part is brown, friable silt loam, and the lower part is dark brown, very firm clay. Hard, fractured limestone is at a depth of about 16 inches. In some areas the surface layer is dark grayish brown silt loam about 7 inches thick.

Permeability is moderate. Available water capacity is very low. Surface runoff is medium. Tilth is fair. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and in the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are wooded or are used as permanent pasture. A few are cultivated. This soil is poorly suited to cultivated crops because it is droughty and is subject to erosion. It has a very limited root zone, and tillage is very difficult because of the shallowness to bedrock and the limestone slabs on the surface.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation,

timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

Although most areas support native hardwoods, this soil is poorly suited to trees because it is droughty and has a limited root zone. Seedling mortality is severe, and the hazard of erosion and the equipment limitation are moderate. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Plant competition should be controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVs.

499D—Nordness silt loam, 5 to 14 percent slopes. This moderately sloping and strongly sloping, well drained soil is on narrow ridges and convex side slopes in the uplands. Areas are long and narrow and range from 10 to 25 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 2 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil is about 7 inches thick. It has common limestone fragments. The upper part is brown, friable silt loam, and the lower part is dark brown and reddish brown, very firm clay. Hard, fractured limestone is at a depth of about 12 inches. In some areas limestone fragments crop out. In other areas the surface layer is brown silt loam about 7 inches thick.

Permeability is moderate. Available water capacity is very low. Surface runoff is rapid. Tilth is poor because of the shallowness to limestone bedrock and the limestone fragments throughout the soil. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and in the subsoil. The subsoil generally has a very low supply of available potassium.

Most areas are wooded or are used as permanent pasture. A few are used for corn, oats, or grass-legume meadows. This soil generally is not suited to cultivated crops because it is droughty and is subject to erosion. It has a very limited root zone, and tilling is very difficult because of the exposed bedrock and limestone slabs.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

Although most areas support native hardwoods, this soil is poorly suited to trees because it has a limited root zone and is droughty. Seedling mortality is severe, and the hazard of erosion and the equipment limitation are moderate. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Plant competition should be controlled by careful site preparation or by spraying and cutting.

The capability subclass is VIs.

499F—Nordness silt loam, 14 to 25 percent slopes. This moderately steep and steep, well drained soil is on convex side slopes in the uplands. Areas are elongated and range from 10 to 40 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 1 inch thick. The subsurface layer is dark grayish brown silt loam is about 2 inches thick. The subsoil is about 5 inches thick. The upper part is brown, friable silt loam, and the lower part is dark brown and reddish brown, very firm clay. Hard, fractured limestone is at a depth of about 8 inches.

Included with this soil in mapping are many areas where limestone bedrock crops out at the base of the slopes. These areas make up about 10 percent of the unit.

Permeability is moderate. Available water capacity is very low. Surface runoff is rapid. Tilth is poor. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and in the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are wooded or used as permanent pasture. This soil generally is not suited to cultivated crops because it is extremely erodible, very droughty, shallow to limestone, and low in fertility. Tilling is very difficult because of the exposed bedrock and limestone slabs. Also, operating ordinary farm machinery is very difficult because of the slope.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

Although most areas support native hardwoods, this soil is poorly suited to trees because it has a limited root zone and is very droughty. Seedling mortality is severe, and the hazard of erosion and the equipment limitation are moderate. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Plant competition should be controlled by careful site preparation or by spraying or cutting. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment and caution in operating the equipment are needed.

The capability subclass is VIIs.

512B—Marlean loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on ridges and side slopes in the uplands. Areas are about 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is dark brown, friable loam about 4 inches thick. The substratum to a depth of about 60 inches is mixed very dark grayish brown, dark brown, and brown very channery loam.

Included with this soil in mapping are a few areas where cultivating is difficult because coarse limestone fragments are on the surface. The soils in these areas are more droughty than the Marlean soil. They are on convex side slopes. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Marlean soil and moderately rapid in the substratum. Available water capacity is low. Surface runoff is medium in cultivated areas. Tilth is poor because of the coarse fragments close to the surface. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are pastured. A few are cultivated. This soil is poorly suited to corn, soybeans, and small grain because it is droughty and cannot be easily tilled. Also, it is subject to erosion if it is cultivated. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The fragmented limestone at a depth of 8 to 18 inches hinders the construction of terraces. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants helps to control erosion. Overgrazing, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in fairly good condition.

The capability subclass is IVs.

512D2—Marlean loam, 5 to 14 percent slopes, moderately eroded. This moderately sloping and strongly sloping, well drained soil is on convex side slopes in the uplands. Areas are about 5 to 10 acres in size and are elongated.

Typically, the surface layer is very dark grayish brown and brown loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is brown, friable loam about 4 inches thick. The substratum to a depth of about 60 inches is mixed very dark grayish brown, dark brown, and brown very channery loam.

Included with this soil in mapping are areas where cultivating is difficult because coarse limestone fragments are on the surface. The soils in these areas are more droughty than the Marlean soil. They are at the base of the side slopes. They make up about 10 percent of the unit.

Permeability is moderate in the upper part of the Marlean soil and moderately rapid in the substratum. Available water capacity is low. Surface runoff is rapid in cultivated areas. Tilth is poor because of the coarse fragments close to the surface. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are pastured. A few are cultivated. This soil generally is not suited to corn and soybeans and is poorly suited to small grain and to grasses and legumes for hay and pasture. It is droughty and is highly susceptible to erosion if it is cultivated. Also, it cannot be easily tilled. Cultivated crops should be grown only to reestablish pasture.

A cover of pasture plants helps to control erosion. Overgrazing, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in fairly good condition.

The capability subclass is VIs.

551—Calamine loam, 1 to 3 percent slopes. This very gently sloping, poorly drained and very poorly drained soil is on foot slopes on high benches below limestone bluffs. Areas are irregularly shaped and range from 10 to 30 acres in size.

Typically, the surface layer is black loam about 6 inches thick. The subsurface layer is black clay loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is dark gray, friable clay loam mottled with olive gray; the next part is olive gray, friable clay loam mottled with olive and yellowish brown; and the lower part is mottled greenish gray and light olive brown, extremely firm silty clay. Mottled greenish gray and olive yellow, extremely firm silty clay shale is at a depth of about 36 inches. In some areas the surface soil is less than 10 inches thick.

Included with this soil in mapping are areas where the depth to clayey shale is 48 inches or more and a sandy layer as much as 2 feet thick is common above the clayey shale. These areas cannot be drained easily. They are on the upper parts of the foot slopes. They make up 2 to 8 percent of the unit.

The Calamine soil is moderately permeable in the upper part and very slowly permeable in the lower part of the subsoil and in the substratum. It has a seasonal high water table. Available water capacity is moderate. Surface runoff is slow. Tilth is poor. The soil dries out very slowly and receives runoff from the soils and springs upslope. It puddles if worked when wet and is hard and cloddy when dry. The content of organic matter is about 8 to 10 percent in the surface layer. The surface

soil and subsoil typically are neutral to mildly alkaline, and the substratum generally is mildly alkaline and strongly effervescent. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are used as permanent pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in fairly good condition.

This soil is poorly suited to corn and soybeans because it is wet. A drainage system is needed but cannot be installed easily. Tiling is difficult because the depth to clayey shale varies from area to area. Tile drains should not be installed in the clayey shale, and the backfill material should be porous.

This soil is poorly suited to trees because it has a seasonal high water table and remains wet for long periods after rainfall. The shale bedrock restricts root penetration. The equipment limitation, seedling mortality, and the windthrow hazard are severe. Ordinary logging equipment should be used only during the drier periods or during the winter, when the ground is frozen. Because they do not survive well, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees.

The capability subclass is IIw.

589—Otter silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land and low benches along streams and rivers. It is subject to flooding. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is black silt loam about 23 inches thick. The substratum to a depth of about 60 inches is dark gray, grayish brown, and light olive brown silt loam.

Included with this soil in mapping are small areas that have received 6 to 18 inches of lighter colored silt loam overwash. The soils in these areas are less fertile than the Otter soil and have a lower content of organic matter. They are near the streams. They make up 4 to 10 percent of the unit.

The Otter soil is moderately permeable. It has a seasonal high water table. Available water capacity is high or very high. Surface runoff is very slow or ponded. Tilth is poor. The soil puddles readily if worked when wet and is hard and cloddy when dry. The content of organic matter is about 5 to 7 percent in the surface layer. Reaction typically is slightly acid or neutral in the surface soil and neutral in the substratum. The supply of available phosphorus generally is low, and the supply of available potassium is very low.

Most areas are cultivated. Some are pastured. If drained and protected from floodwater, this soil is suited to corn, soybeans, and small grain. It is wet as a result of the flooding, the very slow or ponded runoff, and the seasonal high water table. The floodwater damages crops during some periods of heavy rainfall. Tile drains function well if suitable outlets are available. Diversion terraces help to control the floodwater.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing or grazing during wet periods, however, increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is poorly suited to trees because it is subject to flooding, has a seasonal high water table, and remains wet for long periods after rainfall. The equipment limitation is severe, and seedling mortality and the windthrow hazard are moderate. Ordinary logging equipment should be used only during the drier periods or during the winter, when the ground is frozen. Because they do not survive well, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees.

The capability subclass is IIw.

589+—Otter silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land and on the lower parts of broad drainageways in the uplands. It is subject to flooding. Areas are elongated on the bottom land and irregularly shaped in the upland drainageways. They range from 5 to 80 acres in size.

Typically, the surface layer is stratified dark grayish brown, grayish brown, dark gray, and very dark gray silt loam about 18 inches thick. The next 31 inches is an older buried surface layer of black silt loam. The substratum to a depth of about 60 inches is gray silt loam mottled with olive brown and light olive brown. In some areas the surface layer is brown and grayish brown silt loam.

This soil is moderately permeable. It has a seasonal high water table. Surface runoff is very slow. Available water capacity is high or very high. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is neutral or slightly acid in the upper surface layer and neutral in the buried surface layer. The supply of available phosphorus generally is low or medium, and the supply of available potassium is very low.

Many areas are cultivated. Some are used as permanent pasture. If drained and protected from floodwater, this soil is suited to corn, soybeans, and oats. It is wet as a result of the seasonal high water table, the very slow runoff, and the flooding. It receives runoff from the more sloping soils upslope. Establishing diversion terraces on those soils helps to prevent

siltation on this soil. Tile drains function well if suitable outlets are available.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing or grazing during wet periods, however, increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is poorly suited to trees because it is subject to flooding, has a seasonal high water table, and remains wet for long periods after rainfall. The equipment limitation is severe, and seedling mortality and the windthrow hazard are moderate. Ordinary logging equipment should be used only during the drier periods or during the winter, when the ground is frozen. Because they do not survive well, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees.

The capability subclass is IIw.

612D2—Mottland silt loam, 5 to 14 percent slopes, moderately eroded. This moderately sloping and strongly sloping, well drained soil is on convex side slopes in the uplands. Areas are about 5 to 10 acres in size and are elongated.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. Below this is mixed dark brown and brown silt loam about 3 inches thick. The substratum to a depth of about 60 inches is brownish yellow and yellow channery sandy loam.

Included with this soil in mapping are areas where the depth to channery sandy loam is less than 7 inches. These areas are on the lower parts of the side slopes. Also included are small areas where limestone fragments are on the surface. These areas are near the base of the side slopes. The soils in the included areas are less fertile than the Mottland soil, have a lower content of organic matter, and are more droughty. They make up less than 10 percent of the unit.

Permeability is moderate in the upper part of the Mottland soil and moderately rapid in the substratum. Available water capacity is moderate. Surface runoff is rapid in cultivated areas. Tilth is fair or poor. The soil tends to crust after heavy rainfall. The crusting increases the runoff rate and retards plant growth. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is neutral or mildly alkaline in the surface layer and mildly alkaline or moderately alkaline in the substratum. The supply of available phosphorus and potassium generally is very low.

Many areas are cultivated. Some are pastured. This soil is poorly suited to cultivated crops. It is highly susceptible to erosion if cultivated, and it is droughty unless rainfall is above normal and timely. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The soil is poorly suited to terracing because deep cuts may expose the hard limestone bedrock. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

612E2—Mottland silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on short, convex side slopes in the uplands. Areas are about 5 to 10 acres in size and are elongated.

Typically, the surface layer is mixed very dark grayish brown, dark brown, and brown silt loam about 8 inches thick. The content of limestone fragments in this layer is about 10 percent. The substratum to a depth of about 60 inches is brownish yellow and yellow channery sandy loam. In some areas the surface layer is brown silt loam.

Included with this soil in mapping are areas where the depth to channery sandy loam is less than 7 inches. These areas are on the lower parts of the slopes. Also included are small areas where limestone fragments are on the surface. These areas are near the base of the slopes. The soils in the included areas are less fertile than the Mottland soil, have a lower content of organic matter, are more droughty, and cannot be cultivated so easily. They make up 4 to 10 percent of the unit.

Permeability is moderate in the surface layer of the Mottland soil and moderately rapid in the substratum. Available water capacity is moderate. Surface runoff is rapid in cultivated areas. Tilth is poor. The soil tends to crust after heavy rainfall. The crusting increases the runoff rate and retards plant growth. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is neutral or mildly alkaline in the surface layer and mildly alkaline or moderately alkaline in the substratum. The supply of available phosphorus and potassium generally is very low.

Many areas are pastured. Some are cultivated. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is highly susceptible to erosion if cultivated, and it is droughty unless rainfall is above normal and timely. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The soil is not suitable for terracing because it is moderately steep and because deep cuts may expose the hard limestone bedrock. Returning crop

residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IVe.

714B—Winneshiek loam, 20 to 30 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and side slopes in the uplands. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 19 inches thick. The upper part is brown, friable loam; the next part is dark yellowish brown, friable clay loam; and the lower part is yellowish brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 27 inches.

Included with this soil in mapping are small areas where the limestone hinders fieldwork because it is near the surface or is exposed. These areas are near the base of the side slopes. They make up 2 to 8 percent of the unit.

Permeability is moderate in the Winneshiek soil. Available water capacity is low. Surface runoff is medium. Tilth is good. The soil warms up quickly in the spring and generally can be worked soon after rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Many areas are pastured. Some are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is subject to erosion, however, and is droughty in years of average or below average rainfall. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. The soil is not well suited to terracing because of the shallowness to limestone bedrock. Returning crop residue to the soil or regularly adding other organic material conserves moisture and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. The pasture can be easily overstocked because the available water capacity is low. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Tree growth may be limited, however, by the low available water capacity, and root penetration may be restricted by the hard limestone bedrock. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIe.

714C—Winneshiek loam, 20 to 30 inches to limestone, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex ridges and side slopes in the uplands. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 3 inches thick. The subsoil is about 14 inches thick. The upper part is brown, friable loam; the next part is dark yellowish brown, friable clay loam; and the lower part is brown, very firm clay. Hard, fractured limestone bedrock is at a depth of about 24 inches. In some areas the surface layer is dark grayish brown loam.

Included with this soil in mapping are small areas where the limestone hinders fieldwork because it is near the surface or is exposed. These areas are near the base of the side slopes. They make up 3 to 8 percent of the unit.

Permeability is moderate in the Winneshiek soil. Available water capacity is low. Surface runoff is medium. Tilth is good. The soil warms up quickly in the spring and generally can be worked soon after rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and neutral or slightly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are pastured. Some are cultivated. This soil is poorly suited to corn, soybeans, and small grain. It is subject to erosion and is droughty in years of average or below average rainfall. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. The soil is not well suited to contour farming or terracing because slopes generally are short and irregular and limestone is 20 to 30 inches from the surface. Returning crop residue to the soil or regularly adding other organic material conserves moisture and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. The pasture can be easily overstocked, however, because available water capacity is low. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Tree growth may be limited, however, by the low available water capacity, and root penetration may be restricted by the hard limestone bedrock. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

763D2—Exette silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on short, convex side slopes and in coves along upland drainageways. Areas are elongated and are 5 to 15 acres in size.

Typically, the surface layer is mixed dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is friable silt loam about 33 inches thick. The upper part is brown, the next part is dark yellowish brown and is mottled with strong brown and grayish brown, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam that has large, yellowish red iron accumulations. In some areas the upper part of the subsoil is grayish brown throughout.

Permeability is moderate. Available water capacity is very high. Surface runoff is rapid. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are pastured. This soil is suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. Further erosion is a hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and grassed waterways help to prevent excessive soil loss (fig. 16). The soil is not well suited to terracing because the slopes are short and complex and the subsoil is very erodible if it is exposed by deep cuts. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

763D3—Exette silt loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is in coves along upland drainageways and on short, convex side slopes that are dissected by many small drainageways. Areas are irregularly shaped and are 10 to 20 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is friable silt loam about 29 inches thick. The upper part is dark yellowish brown and is mottled with grayish brown, the next part is dark yellowish brown and is mottled with strong brown and grayish brown, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam that has large, yellowish red iron accumulations. In some areas the subsoil is grayish brown throughout.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is rapid. Tilth is poor. The soil is cloddy after it has been worked when wet and tends to puddle during periods of heavy rainfall. The cloddiness and puddling increase the runoff rate and retard plant growth. The content of organic matter is less than 0.5 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Some are pastured or wooded. This soil is suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. Further erosion is a serious hazard, however, if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The soil generally is not well suited to terracing because the slopes are short and complex and the subsoil is very erodible if it is exposed by deep cuts. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. More nitrogen generally is needed on this soil than on less eroded Exette soils. Also, more intensive management is needed to improve tilth.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVe.

Figure 16.—Contour stripcropping on Exette silt loam, 9 to 14 percent slopes, moderately eroded.

763E2—Exette silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is in coves along upland drainageways and on short, convex side slopes. Areas are elongated and are 5 to 15 acres in size.

Typically, the surface layer is mixed dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is friable silt loam about 31 inches thick. The upper part is dark yellowish brown, the next part is dark yellowish brown and is mottled with strong brown and grayish brown, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam that has large, yellowish red iron accumulations. In some areas it is yellowish brown loam.

Permeability is moderate. Available water capacity is very high. Surface runoff is rapid. Tilth is fair. The soil is cloddy after it has been worked when wet and tends to puddle during periods of heavy rainfall. The cloddiness and puddling increase the runoff rate and retard plant growth. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Some are pastured or wooded. This soil is poorly suited to cultivated crops. Further erosion is a hazard if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent

excessive soil loss. The soil generally is not suitable for terracing because the slopes are too steep and are short and complex. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is moderately well suited to trees. Seedlings survive and grow well, but the hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment and caution in operating the equipment are needed.

The capability subclass is IVe.

763E3—Exette silt loam, 14 to 18 percent slopes, severely eroded. This moderately steep, well drained soil is in coves along upland drainageways and on short, convex side slopes that have been dissected by many small waterways. Areas are irregularly shaped and are 5 to 15 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is friable silt loam about 27 inches thick. The upper part is dark yellowish brown and is mottled with grayish brown, the next part is dark yellowish brown and is mottled with strong brown and grayish brown, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is grayish brown, mottled silt loam that has large, yellowish red iron accumulations. In some areas it is brown loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is very rapid. Tilth is poor. The soil is cloddy after it has been worked when wet and tends to puddle during periods of heavy rainfall. The cloddiness and puddling increase the runoff rate and retard plant growth. The content of organic matter is less than 0.5 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Some are pastured or wooded. This soil generally is not suited to cultivated crops because further erosion is a serious hazard. These crops should be grown only to reestablish hay and pasture.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is moderately well suited to trees. Seedlings survive and grow well, but the hazard of erosion and the equipment limitation are moderate. Carefully selecting logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment and caution in operating the equipment are needed.

The capability subclass is VIe.

763F2—Exette silt loam, 18 to 25 percent slopes, moderately eroded. This steep, well drained soil is in coves along upland drainageways and on short, convex side slopes that are dissected by many small waterways. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is brown silt loam about 6 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is friable silt loam about 32 inches thick. The upper part is brown, the next part is yellowish brown and is mottled with strong brown and grayish brown, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam that has large, yellowish red iron accumulations. In some areas it is yellowish brown loam.

Permeability is moderate. Available water capacity is very high. Surface runoff is very rapid in cultivated areas. Tilth is poor. The soil is cloddy after it has been worked when wet and tends to puddle during periods of heavy rainfall. The cloddiness and puddling increase the runoff rate and retard plant growth. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are pastured. This soil generally is not suited to cultivated crops and is only moderately well suited to hay, mainly because further erosion is a serious hazard. Also, operating farm machinery is difficult because of the steep slope and the many small waterways. Cultivated crops should be grown only to reestablish hay and pasture.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is moderately well suited to trees. Seedlings survive and grow well, but the hazard of erosion and the

equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment and caution in operating the equipment are needed.

The capability subclass is VIe.

763F3—Exette silt loam, 18 to 25 percent slopes, severely eroded. This steep, well drained soil is on short, convex side slopes on uplands dissected by many small waterways and gullies. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is friable silt loam about 25 inches thick. The upper part is dark yellowish brown and is mottled with grayish brown, the next part is dark yellowish brown and is mottled with strong brown and grayish brown, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam that has large, yellowish red iron accumulations. In some areas the upper part of the subsoil is grayish brown. In other areas the substratum is yellowish brown loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff is very rapid. Tilth is poor. The soil is cloddy after it has been worked when wet and tends to puddle during periods of heavy rainfall. The cloddiness and puddling increase the runoff rate and retard plant growth. The content of organic matter is less than 0.5 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are pastured. Some are cultivated. This soil generally is not suited to cultivated crops and is only moderately well suited to hay, mainly because further erosion is a serious hazard. Also, operating farm machinery is difficult because of the steep slope and the many gullies and waterways. Cultivated crops should be grown only to reestablish pasture and hay.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fairly good condition.

This soil is moderately well suited to trees. Seedlings survive and grow well, but the hazard of erosion and the equipment limitation are moderate. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment and caution in operating the equipment are needed.

The capability subclass is VIe.

776B—Lilah sandy loam, 2 to 5 percent slopes. This gently sloping, excessively drained soil is on stream benches and in outwash areas on uplands. Areas are irregularly shaped and are 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is brown and dark grayish brown sandy loam about 5 inches thick. The subsoil is very friable loamy sand about 29 inches thick. The upper part is brown, and the lower part is strong brown. The content of fine gravel is about 5 percent in the upper part and 5 to 10 percent in the lower part. The substratum to a depth of about 60 inches is strong brown and yellowish brown loamy sand. In some areas it is sand and gravel.

Included with this soil in mapping are small areas of soils that have a thicker and darker surface layer and are higher in organic matter content and fertility. These soils are on the stream benches. They make up less than 5 percent of the unit.

Permeability is rapid in the upper part of the Lilah soil and very rapid in the subsoil and substratum. Available water capacity is low or very low. Surface runoff is slow. Tilth is poor because of the coarse texture. The content of organic matter is less than 1 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and in the upper part of the subsoil. It varies widely in the surface layer because of local liming practices. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated or used as permanent pasture. This soil is poorly suited to corn, soybeans, oats, and hay and pasture. It is droughty and low in fertility. The response to fertilizer is poor. Also, erosion is a hazard if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. The soil is poorly suited to terracing because it is highly erodible.

A cover of pasture plants or hay helps to control erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in fairly good condition.

A few areas are wooded. This soil is moderately suited to trees. Establishing seedlings is difficult, and seedling mortality is severe. The sand and gravel within 12 to 24 inches of the surface restrict the depth to which the roots of seedlings can penetrate. Because they do not survive well, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees.

The capability subclass is IVs.

776C—Lilah sandy loam, 5 to 9 percent slopes. This moderately sloping, excessively drained soil is in outwash areas on uplands. Areas are irregularly shaped and are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam about 3 inches thick. The subsoil is very friable loamy sand about 29 inches thick. The upper part is brown, and the lower part is strong brown. The content of fine gravel is about 5 percent in the upper part and 5 to 15 percent in the lower part. The substratum to a depth of about 60 inches is strong brown loamy sand.

Included with this soil in mapping are small areas of soils that have a thinner and lighter colored surface layer, are moderately eroded, and are lower in content of organic matter and fertility. These soils are on the upper parts of the slopes. They make up less than 5 percent of the unit.

Permeability is rapid in the upper part of the Lilah soil and very rapid in the subsoil and substratum. Available water capacity is low or very low. Surface runoff is medium. Tilth is poor because of the coarse texture. The content of organic matter is less than 1 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and in the upper part of the subsoil. It varies widely in the surface layer because of local liming practices. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated or are used as permanent pasture. This soil is poorly suited to corn, soybeans, oats, and hay and pasture. It is droughty and low in fertility. The response to fertilizer is poor. Also, erosion is a hazard if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. The soil is poorly suited to terracing because it is highly erodible.

A cover of pasture plants or hay helps to control soil blowing and water erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture and the soil in fairly good condition.

A few areas are wooded. This soil is moderately well suited to trees. Establishing seedlings is difficult, and seedling mortality is severe. The sand and gravel within 12 to 24 inches of the surface restrict the depth to which the roots of seedlings can penetrate. Because they do not survive well, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees.

The capability subclass is IVs.

777—Wapsie loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream benches. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 30 inches thick. The upper part is brown, friable loam; the next part is yellowish brown, friable loam; and the lower part is brown, very friable sandy loam and gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly sand.

Included with this soil in mapping are small areas of soils that have a sandy loam or gravelly loamy sand surface layer. These soils are more droughty than the Wapsie soil. They are near the edge of the benches. They make up less than 5 percent of the unit. Also included, on the benches near the uplands, are small areas of soils that have a thinner and lighter colored surface layer and are lower in content of organic matter and fertility than the Wapsie soil. These soils make up less than 5 percent of the unit.

Permeability is moderate in the upper part of the Wapsie soil and very rapid in the lower part. Available water capacity is low or moderate. Surface runoff is slow. Tilth is good. The soil warms up quickly in the spring and generally can be worked soon after rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Many areas are cultivated. Some areas are pastured or wooded. This soil is suited to corn, soybeans, and small grain. It is somewhat droughty, however, particularly in years of average or below average rainfall. Also, it is subject to soil blowing during some periods. If cultivated crops are grown, the hazard of water erosion is only slight. A system of conservation tillage that leaves crop residue on the surface conserves moisture and helps to prevent excessive soil blowing.

This soil is suited to grasses and legumes for hay and pasture. The pastures can be easily overstocked, however, because the available water capacity is low or moderate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

This soil is moderately well suited to trees. Tree growth may be limited, however, by the low or moderate available water capacity, and root penetration may be restricted by the gravelly sand substratum. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIs.

777B—Wapsie loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream benches. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 25

inches thick. The upper part is brown, friable loam; the next part is dark yellowish brown and yellowish brown, friable loam; and the lower part is brown, loose gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly sand.

Included with this soil in mapping are a few areas of soils that have a sandy loam surface layer. These soils are more droughty than the Wapsie soil. They are near the edges of the benches. They make up less than 5 percent of the unit.

Permeability is moderate in the upper part of the Wapsie soil and very rapid in the lower part. Available water capacity is low or moderate. Surface runoff is medium. Tilth is good. The soil warms up quickly in the spring and generally can be worked soon after rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Many areas are cultivated. Some are pastured or wooded. This soil is suited to corn, soybeans, and small grain. Soil blowing and water erosion are hazards, however, if cultivated crops are grown. Also, the soil is droughty, especially in years of average or below average rainfall. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming is difficult because the slopes generally are short and irregular. The soil is not well suited to terracing because of the coarse textured substratum. Returning crop residue to the soil conserves moisture.

This soil is suited to grasses and legumes for hay and pasture. The pastures can be easily overstocked, however, because the available water capacity is low or moderate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

This soil is moderately well suited to trees. Tree growth may be limited, however, by the low or moderate available water capacity, and root penetration may be restricted by the gravelly sand substratum. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIe.

793—Bertrand silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on benches along the major streams and rivers. Areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown and yellowish brown silt loam about 9 inches thick. The subsoil is yellowish brown, friable silt loam about 35 inches thick. The substratum to a depth of about 60 inches is yellowish brown, stratified silt loam and loamy sand.

Included with this soil in mapping are a few areas of soils that have gravelly sand in the lower part of the subsoil and in the substratum. These soils are droughty in some years of below average rainfall. They are near the edges of the benches. They make up less than 5 percent of the unit.

Permeability is moderate in the upper part of the Bertrand soil and moderately rapid in the substratum. Available water capacity is high or very high. Surface runoff is slow in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting retard plant growth. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain. If cultivated crops are grown, the hazard of erosion is only slight. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Because it is below areas of more sloping upland soils, the soil is subject to siltation. Diversion terraces are needed in some areas to control local runoff. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

A few areas are wooded. This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability class is I.

826—Rowley silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low benches along small rivers and streams. It is subject to flooding. Areas are about 10 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam about 8 inches thick. The subsurface layer is black and very dark gray silt loam about 11 inches thick. The subsoil is friable silt loam about 30 inches thick. The upper part is dark grayish brown and is mottled with light olive brown, and the lower part is grayish brown and is mottled with yellowish brown and strong brown. The substratum to a depth of about 60 inches is stratified grayish brown and

yellowish brown silt loam and loamy sand. In some areas the upper part of the subsoil is dark gray.

Included with this soil in mapping are a few areas where 6 to 18 inches of lighter colored silty overwash from the adjacent uplands has been deposited on the surface. The soils in these areas are lower in content of organic matter than the Rowley soil. They are near the base of the uplands. They make up less than 5 percent of the unit.

The Rowley soil is moderately permeable. It has a seasonal high water table. Available water capacity is high or very high. Surface runoff is slow. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 3 or 4 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface soil and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain. It is slightly wet, however, and receives runoff from the soils upslope. Establishing diversion terraces on those soils helps to protect this soil from overflow and siltation. Tile drainage improves the timeliness of fieldwork. If row crops are grown year after year, erosion is a slight hazard. A system of conservation tillage that leaves crop residue on the surface, however, helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting. Equipment should be used only during the drier periods.

The capability subclass is IIw.

863B—Fayette silt loam, karst, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges on broad upland plateaus. It is underlain by limestone bedrock at a depth of 6 to 10 feet. Sinkholes make up 30 to 40 percent of the land area. They are 5 to 20 feet deep and 20 to 80 feet wide. They formed when the highly fractured, soluble limestone and dolomite dissolved. They generally are closed, but a few open directly into the limestone bedrock. Areas are irregularly shaped and are about 15 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark gray and dark grayish brown silt loam about 8 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff generally is medium in cultivated areas, but surface water moves very rapidly into the sinkholes. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are wooded or are used as permanent pasture. In a few areas, the sinkholes have been filled and cultivated crops are grown. This soil is poorly suited to corn, soybeans, and small grain. Operating farm machinery is difficult because of the many sinkholes. Also, new sinkholes are likely to form, and filled ones are likely to reopen.

This soil is suited to pasture. Animal waste is likely to enter the sinkholes, however, unless the surrounding area is fenced. Overgrazing causes surface compaction and increases the rate at which runoff enters the sinkholes. Excessive runoff could cause contamination of the ground water. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

This soil is well suited to trees, but harvesting is hindered by the sinkholes. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVe.

863D—Fayette silt loam, karst, 5 to 14 percent slopes. This moderately sloping and strongly sloping, well drained soil is on convex ridges and side slopes on broad upland plateaus. It is underlain by limestone bedrock at a depth of about 5 to 8 feet. Sinkholes make up about 40 to 45 percent of the land area. They are 10 to 20 feet deep and 20 to 50 feet wide. They formed when the highly fractured, soluble limestone and dolomite dissolved. They generally are closed, but a few open directly into the limestone bedrock. Areas are irregularly shaped and range from 10 to 25 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark gray and dark grayish brown silt loam about 5 inches thick. The subsoil is about 33 inches thick. It is friable. The upper part is brown silty clay loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam.

Permeability is moderate. Available water capacity is high or very high. Surface runoff generally is rapid in

cultivated areas, but surface water moves very rapidly into the sinkholes. Tilth is fair. If cultivated, the soil tends to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and strongly acid in the upper part of the subsoil. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are wooded or are used as permanent pasture. This soil generally is unsuitable for cultivated crops. Operating farm machinery is difficult because of the many sinkholes and the likelihood that new sinkholes will form. Also, the hazards of erosion and runoff are severe.

A cover of pasture plants helps to control erosion. Animal waste is likely to enter the sinkholes, however, unless the surrounding area is fenced. Overgrazing causes surface compaction and increases the rate at which runoff enters the sinkholes. Excessive runoff could cause contamination of the ground water. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

This soil is well suited to trees, but harvesting is hindered by the sinkholes. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is VIIe.

902C—Luana silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex ridges and side slopes in the uplands. Areas are about 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is yellowish brown, friable silt loam; and the lower part is brownish yellow, firm silty clay. The substratum to a depth of about 60 inches is yellow flaggy sandy loam. In some areas the surface layer is very dark brown silt loam about 10 inches thick.

Included with this soil in mapping are small areas of Mottland soils near the base of the side slopes. These soils are underlain by channery sandy loam at a depth of 7 to 20 inches and are more droughty than the Luana soil. They make up 2 to 5 percent of the unit.

Permeability is moderate in the upper part of the Luana soil and moderately rapid in the substratum. Available water capacity is moderate or high. Surface runoff is medium in cultivated areas. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are pastured. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion is a moderate hazard, however, if cultivated crops are grown. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone. A scarcity of moisture is likely to result in crop damage unless rainfall is timely during the growing season. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The soil is only moderately well suited to terracing because deep cuts may expose the hard limestone bedrock. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIIe.

902D2—Luana silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex side slopes in the uplands. Areas are about 5 to 15 acres in size and are elongated.

Typically, the surface layer is mixed very dark grayish brown and brown silt loam about 8 inches thick. Plowing has mixed the upper part of the subsoil with the surface layer. The subsoil is about 23 inches thick. The upper part is brown, friable silt loam; the next part is yellowish brown, friable silt loam and silty clay loam; and the lower part is brownish yellow, very firm silty clay. The substratum to a depth of about 60 inches is yellow flaggy sandy loam. In some areas the surface layer is brown silty clay loam.

Included with this soil in mapping are areas of Mottland soils and small areas where limestone fragments are on the surface. These areas are near the base of the side slopes. They are more droughty than the Luana soil. They make up 2 to 8 percent of the unit.

Permeability is moderate in the upper part of the Luana soil and moderately rapid in the substratum. Available water capacity is moderate or high. Surface runoff is rapid in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting increase the runoff rate and retard plant growth. The content of organic matter is about 1 to

2 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Some are pastured. This soil is poorly suited to cultivated crops, mainly because it is highly susceptible to erosion. Soil loss through erosion adversely affects cropping by decreasing the depth to limestone. A scarcity of moisture is likely to result in crop damage unless rainfall is timely during the growing season. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The soil is not well suited to terracing because deep cuts may expose the hard limestone bedrock. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IVe.

926—Canoe silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low benches along small rivers and streams. It is subject to flooding. Areas are 10 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is friable silt loam about 33 inches thick. The upper part is mottled grayish brown and yellowish brown, the next part is mottled grayish brown, olive yellow, light olive brown, and light brownish gray, and the lower part is light brownish gray. The substratum to a depth of about 60 inches is gray and light olive gray silt loam. In some areas the surface layer is dark gray.

Included with this soil in mapping are a few areas where 6 to 18 inches of lighter colored silty overwash from the adjacent uplands has been deposited on the surface and the content of organic matter is lower. These areas are near the base of the uplands. They make up less than 5 percent of the unit.

The Canoe soil is moderately permeable. It has a seasonal high water table. Available water capacity is very high. Surface runoff is slow. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain. It is slightly wet, however, and receives runoff from the soils upslope. Establishing diversion terraces on those soils helps to protect this soil from overflow and siltation. Tile drainage improves the timeliness of fieldwork. The hazard of erosion is slight if row crops are grown year after year. A system of conservation tillage that leaves crop residue on the surface, however, helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting. Equipment should be used only during the drier periods.

The capability class is I.

930—Orion silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on narrow bottom land and alluvial fans below more sloping soils on loess-covered uplands. It is subject to flooding. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is about 7 inches of dark grayish brown silt loam that has thin strata of dark gray silt loam. The substratum is stratified dark grayish brown, dark gray, and gray silt loam about 22 inches thick. The next 20 inches is an older buried surface layer of black silt loam. The underlying material to a depth of about 60 inches is dark gray silt loam. In some areas the surface layer is very dark gray.

Included with this soil in mapping are small areas of poorly drained soils on the lower lying parts of the bottom land. These soils make up 5 to 10 percent of the unit.

The Orion soil is moderately permeable. It has a seasonal high water table. Available water capacity is very high. Surface runoff is slow. Tilth is poor. The soil dries out slowly and tends to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 3 percent in the surface layer. The soil typically is neutral or slightly acid throughout. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Many areas are used as permanent pasture. Some are cultivated. If drained and protected from floodwater, this soil is suited to corn, soybeans, and small grain. It is wet as a result of the flooding, the slow runoff, and the seasonal high water table. Tile drains function well if suitable outlets are available. In some years the floodwater damages crops during periods of heavy rainfall. It can be controlled, however, by diversion terraces.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing or grazing during wet periods, however, increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is only moderately well suited to trees because it is subject to flooding, has a seasonal high water table, and remains wet for long periods after rainfall. Seedlings can survive if competing vegetation is controlled or removed by careful site preparation or by spraying or cutting.

The capability subclass is IIw.

930B—Orion silt loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is in drainageways below more sloping soils on loess-covered uplands. It is subject to flooding. The drainageways are about 100 to 200 feet wide. Areas are long and irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is about 7 inches of dark grayish brown silt loam that has thin strata of dark gray silt loam. The substratum is stratified dark grayish brown, dark gray, very dark grayish brown, and gray silt loam about 22 inches thick. The next 20 inches is an older buried surface layer of black silt loam. The underlying material to a depth of about 60 inches dark gray silt loam.

Included with this soil in mapping are small areas of poorly drained soils on the lower parts of the drainageways. These soils make up 5 to 10 percent of the unit.

The Orion soil is moderately permeable. It has a seasonal high water table. Available water capacity is very high. Surface runoff is slow. Tilth is poor. The soil dries out slowly and tends to puddle or crust after heavy rainfall. The content of organic matter is about 1 to 3 percent in the surface layer. The soil typically is neutral or slightly acid throughout. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Many areas are used as permanent pasture. Some are cultivated. If drained and protected from floodwater, this soil is suited to corn, soybeans, and small grain. It is wet as a result of the flooding, the slow runoff, and the seasonal high water table. Tile drains function well if suitable outlets are available. The soil receives high velocity, concentrated runoff from the more sloping soils on adjacent uplands. It can be protected from this water by diversion terraces on the adjacent uplands.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing or grazing during wet periods, however, increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is only moderately well suited to trees because it has a seasonal high water table and frequently receives high velocity runoff from the more sloping upland soils. Seedlings can survive if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIw.

951F—Medary Variant silt loam, 18 to 30 percent slopes. This steep and very steep, moderately well drained soil is on the escarpments of high benches along tributaries of the Mississippi River. Areas are elongated and range from 5 to 25 acres in size.

Typically, the surface layer is very dark gray silt loam about 5 inches thick. The subsoil is about 26 inches thick. The upper part is brown, firm silty clay loam; the next part is reddish brown, very firm silty clay; and the lower part is brown, firm silty clay. The upper part of the substratum is yellowish brown silt loam. The lower part to a depth of about 60 inches is stratified yellowish brown, brownish yellow, and grayish brown coarse silt and fine sand. It is mildly alkaline and calcareous. In some areas the surface layer is dark brown.

This soil is very slowly permeable in the subsoil and moderately rapidly permeable in the substratum. It has a seasonal high water table. Available water capacity is moderate. Surface runoff is rapid. Tilth is poor. When wet, the soil puddles easily, is sticky, and cannot be easily worked. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface layer and medium acid or strongly acid in the upper part of the subsoil. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used as permanent pasture. This soil generally is unsuitable for cultivated crops. Erosion is a severe hazard if cultivated crops are grown. Many areas are too steep for the use of ordinary farm machinery.

This soil is poorly suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and excessive runoff and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods are needed.

This soil is poorly suited to trees. Establishing seedlings is difficult, and tree roots do not grow well in the clayey subsoil. The equipment limitation is severe,

and the hazard of erosion, seedling mortality, and the windthrow hazard are moderate. Seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Carefully selecting sites for logging trails or roads and laying out the trails or roads on the contour or nearly on the contour help to control erosion. Because of the slope, special logging equipment and caution in operating the equipment are needed.

The capability subclass is VIIe.

977—Richwood silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on benches along the major streams and rivers. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown and dark brown silt loam about 12 inches thick. The subsoil is friable silt loam about 25 inches thick. The upper part is brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown and strong brown. It is silt loam in the upper part and sandy loam in the lower part. In some areas it is silt loam to a depth of 60 inches.

Permeability is moderate in the upper part of the soil and rapid in the lower part of the substratum. Available water capacity is high or very high. Surface runoff is slow. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 5 percent in the surface layer. The surface soil typically is neutral or slightly acid. The subsoil is slightly acid or medium acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain. It occasionally receives local runoff from the soils upslope. Establishing diversion terraces on those soils, however, helps to protect this soil from overflow and siltation. Erosion is a slight hazard if row crops are grown year after year. It can be controlled, however, by a system of conservation tillage that leaves crop residue on the surface. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability class is I.

978—Festina silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on benches along the major streams and rivers. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is yellowish brown, friable silt loam about 30 inches thick. The substratum to a depth of about 60 inches is yellowish brown silt loam that has lenses of brown loamy sand.

Permeability is moderate in the subsoil and moderately rapid in the substratum. Available water capacity is very high. Surface runoff is slow in cultivated areas. Tilth is good, but the soil tends to crust after heavy rainfall. The content of organic matter is about 2 to 3 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. A few are wooded. This soil is well suited to corn, soybeans, and small grain. Because it is below areas of more sloping upland soils, it is subject to siltation. Diversion terraces are needed in some areas to protect the soil from local runoff. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and increases the likelihood of puddling. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability class is I.

981B—Worthen silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on alluvial fans and foot slopes at the base of loess-covered uplands and on the upper parts of a few narrow, U-shaped drainageways in the uplands. Areas are elongated and are 5 to 10 acres in size.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 22 inches thick. The subsoil is friable silt loam about 24 inches thick. The upper part is brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown silt loam that has a few grayish brown and strong brown mottles.

Included with this soil in mapping are a few moderately sloping areas on the foot slopes. The soils in these areas are more susceptible to erosion than the Worthen soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Worthen soil. Available water capacity is high. Surface runoff is medium in cultivated areas. Tilth is good. The content of organic matter is about 3 to 5 percent in the surface layer. Reaction typically is neutral or slightly acid in the surface layer and slightly acid or medium acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It receives runoff from the more sloping soils upslope, however, and erosion is a slight hazard if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss.

A cover of pasture plants also helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

1158—Dorchester silt loam, channeled, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on narrow valley bottom land along small rivers and streams. It is subject to flooding. It generally is dissected by many old channels and bayous. The channels are filled with water during some part of the year. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The substratum is stratified dark grayish brown, grayish brown, and brown silt loam about 23 inches thick. Below this to a depth of about 60 inches is an older buried surface layer of black and very dark brown silt loam. In some areas the substratum is sandy loam.

Permeability is moderate. Available water capacity is very high. Surface runoff is slow. Tilth is fair. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. Reaction typically is mildly alkaline or moderately alkaline in the recent stratified sediments and neutral in the buried surface layer.

Most areas are used as permanent pasture or are wooded. Very few are cultivated. This soil generally is unsuitable for cultivated crops. The channels generally cannot be crossed by ordinary farm machinery because they are too deep and wet.

This soil is suited to pasture, but it is subject to flooding and siltation. Silt covers the grasses temporarily during some rainy periods. Grazing during these periods reduces the productivity of the pasture by increasing the extent of surface compaction and puddling. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is only moderately well suited to trees because it is subject to flooding and remains wet for moderate periods after rainfall. Seedling mortality is moderate. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by careful site preparation or by spraying or cutting.

The capability subclass is Vw.

1212—Kennebec silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on bottom land along small streams and on alluvial fans at the base of loess-covered uplands. It is subject to flooding. Areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is black silt loam about 8 inches thick. The subsurface layer is very dark brown, black, and very dark grayish brown silt loam about 23 inches thick. The subsoil is friable silt loam about 19 inches thick. The upper part is dark grayish brown, and the lower part is grayish brown and is mottled with brown and light olive brown. The substratum to a depth of about 60 inches is mixed light olive brown and grayish brown, mottled silt loam.

Included with this soil in mapping are small areas that have received 6 to 18 inches of lighter colored silt loam overwash. The soils in these areas are lower in fertility and in content of organic matter than the Kennebec soil. They are near the base of the upland slopes. They make up 2 to 8 percent of the unit.

The Kennebec soil is moderately permeable. It has a seasonal high water table. Available water capacity is very high. Surface runoff is slow in cultivated areas. Tilth is good. The content of organic matter is about 4 to 6 percent in the surface layer. Reaction typically is neutral in the surface soil and subsoil. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. A few are pastured. This soil is well suited to corn, soybeans, and small grain, but the flooding is a hazard and the seasonal high water table a limitation. Diversion terraces are needed in some areas to protect the crops from local runoff. Tile drainage is needed in some years to improve the timeliness of fieldwork.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability subclass is IIw.

1219—Canoe Variant silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on high terraces along the Turkey River. Areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown and light brownish gray silt loam about 9 inches thick. The subsoil is friable silt loam about 28 inches thick. The upper part is grayish brown and is mottled with strong brown, and the lower part is mottled grayish brown and strong brown. The substratum to a depth of about 60 inches is grayish brown silt loam mottled with strong brown. Strata of sand and silt are below a depth of 5 feet.

This soil is moderately permeable. It has a seasonal high water table. Available water capacity is high or very high. Surface runoff is slow in cultivated areas. Tilth is fair. The soil tends to puddle or crust after heavy rainfall. The puddling and crusting retard plant growth. The content of organic matter is about 1 to 3 percent in the surface layer. Reaction typically is slightly acid or medium acid in the surface soil and strongly acid or very strongly acid in the upper part of the subsoil. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain. It receives runoff, however, from the more sloping soils upslope. Also, fieldwork is often delayed in the spring and during other wet periods because of the seasonal high water table. Tile drainage improves the timeliness of fieldwork. Establishing diversion terraces on the adjacent upland slopes helps to protect this soil from overflow and siltation. Erosion is a slight hazard if row crops are grown year after year. It can be controlled, however, by a system of conservation tillage that leaves crop residue on the surface. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting.

The capability class is I.

1490—Caneek silt loam, channeled, 0 to 2 percent slopes. This nearly level, somewhat poorly drained or poorly drained soil is on the islands in the Mississippi River and on bottom land along large rivers and streams. It is subject to flooding. It generally is dissected by many old channels and bayous. Areas are irregularly shaped and range from 15 to 200 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The substratum is stratified dark grayish brown, dark gray, brown, and very dark grayish brown silt loam about 26 inches thick. It has common reddish brown mottles. The next 18 inches is an older buried surface layer of black and very dark gray silt loam. Below this to a depth of about 60 inches is a buried subsoil of dark gray silt loam.

Included with this soil in mapping are small areas of soils that have a sand or fine sand surface layer and are droughty. These soils are adjacent to the Mississippi River. They make up less than 5 percent of the unit. Also included, on bottom land near the Mississippi River, are areas where the stratified silty sediments are more than 40 inches thick. The soils in these areas are more susceptible to flooding and siltation than the Caneek soil. They make up 6 to 10 percent of the unit.

The Caneek soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow. Tilth is poor. The soil dries out slowly and tends to crust after heavy rainfall. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. The soil typically is mildly alkaline or moderately alkaline and slightly effervescent in the upper part. It generally has a very low supply of available phosphorus and potassium.

Most areas are idle or are wooded. A few are used as permanent pasture. This soil generally is unsuited to cultivated crops. Most areas are not easily accessible because they are channeled. The flooding is a hazard and the seasonal high water table a limitation. Some of the less channeled areas along the tributary streams of the Mississippi River are cropped even though they are frequently flooded. In the pastured areas overgrazing or grazing during wet periods causes surface compaction and increases the likelihood of puddling.

This soil generally is unsuited to trees because it has a seasonal high water table and remains wet for long periods after rainfall. In some areas the trees are killed when the water table is raised by the series of dams on the Mississippi River.

The capability subclass is Vw.

5010—Pits, sand and gravel. These open gravel pits and sand pits are on alluvial benches. About 10 to 30 feet of coarse textured material has been removed from the pits, primarily for use in road construction and in construction on farmsteads. Some areas have been reshaped, but most have nearly vertical sides that support little or no vegetation.

Two of the largest pits are on the alluvial benches along the Turkey River. These pits are mined for both sand and gravel. Another large pit is on a bench near the Volga River. Sand from this pit has been mined extensively for use in building local concrete highways.

The potential of the pits for alternative uses varies. A few pits have good potential as future sources of sand and gravel. Some that are no longer mined have good potential as habitat for game birds, such as quail and ruffed grouse, or small animals, such as rabbits. Because of the nearly vertical sides, some pits are limited as sites for recreational development and as wildlife habitat.

No capability class or subclass is assigned.

5030—Pits, limestone quarries. These are pits from which limestone has been quarried, primarily for use as road construction material and agricultural lime. They are 30 or more feet deep and are surrounded by piles of spoil 15 or more feet high. They are irregularly shaped and range from a few acres to as much as 30 acres in size. They have nearly vertical sides. They are dry nearly all the year.

The spoil surrounding the pits varies in texture but is mainly silty and contains various amounts of limestone bedrock. It generally is loess but is loam glacial till surrounding the pits in the southwest corner of the county. In some areas it has been leveled and smoothed, but in other areas it is very uneven. Establishing grasses or trees is fairly easy in the leveled areas. The spoil generally ranges from medium acid to mildly alkaline.

These pits have poor potential for wildlife habitat. A few contain water, but they may be dangerous and are limited as sites for recreational development because of the nearly vertical sides and the varying depth of the water. Onsite investigation is needed to determine the suitability of a specific area.

No capability class or subclass is assigned.

5040—Orthents, loamy. These are nearly level to strongly sloping soils that have been used as borrow areas for construction. They commonly are along U.S. Highway 52 and Iowa Route 13. In some areas the original soil has been removed to a depth of 5 to 20 feet or more, and in other areas the topsoil has been redistributed. The soils range from excessively drained to somewhat poorly drained, depending on the kind of material from which they were derived and the condition of the restored borrow area. Areas typically range from 6 to 50 acres in size.

Typically, the upper 5 feet is yellowish brown and grayish brown, friable silt loam. About 4 to 10 inches of topsoil has been redistributed, often unevenly, throughout some borrow areas. This topsoil is very dark gray to dark grayish brown.

Permeability varies, depending on the texture and density of the soils. Soil material that was once buried 5 to 20 feet or more beneath the surface has less pore space and is more dense than the original surface layer. This previously buried material has not been appreciably affected by the processes of soil formation, such as freezing and thawing. Available water capacity is moderate or low. Surface runoff ranges from slow to rapid. Unless the topsoil has been redistributed, the content of organic matter is very low. As a result, preparing a good seedbed is difficult and drought is a hazard. Reaction ranges from slightly acid to mildly alkaline. The supply of available phosphorus and potassium generally is very low.

Some areas are cultivated. Some are used as permanent pasture or support weeds. These soils commonly are not suited to cultivated crops. They are better suited to small grain and to grasses and legumes for hay and pasture. The areas where topsoil has been redistributed are better suited to cultivation than the other areas. They are used for corn and soybeans. Erosion is a moderate or severe hazard if the more sloping areas are cultivated. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Also, other measures that stabilize the soils are needed.

No capability class or subclass is assigned.

prime farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cropland, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber or is available for those uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable, and the level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at local offices of the Soil Conservation Service.

About 95,000 acres throughout Clayton County, or nearly 20 percent of the total acreage, meets the requirements for prime farmland. About 90,000 acres of this land is used for crops, mainly corn and soybeans. The crops grown on this land account for an estimated two-thirds of the local farm income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, are droughty, cannot be easily cultivated, and generally are less productive.

The map units that are considered prime farmland in Clayton County are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed soil map units."

Some soils that have a seasonal high water table and soils that are frequently flooded qualify for prime farmland only in areas where these limitations have been overcome by a drainage system or flood control. The need for these measures is indicated in parentheses after the name of these soils on the following list. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

The map units that meet the requirements for prime farmland are:

136	Ankeny fine sandy loam, 0 to 2 percent slopes
320	Arenzville silt loam, 0 to 2 percent slopes (where protected from flooding)
129B	Arenzville-Chaseburg silt loams, 1 to 5 percent slopes (where protected from flooding)
291	Atterberry silt loam, 1 to 3 percent slopes (where drained)
171B	Bassett loam, 2 to 5 percent slopes
793	Bertrand silt loam, 0 to 2 percent slopes
551	Calamine loam, 1 to 3 percent slopes (where drained)
490	Caneek silt loam, 0 to 2 percent slopes (where drained and protected from flooding)
926	Canoe silt loam, 0 to 2 percent slopes (where drained)
1219	Canoe Variant silt loam, 0 to 2 percent slopes (where drained)
142	Chaseburg silt loam, 0 to 2 percent slopes (where protected from flooding)
84	Clyde clay loam, 1 to 3 percent slopes (where drained)
391B	Clyde-Floyd complex, 1 to 4 percent slopes (where drained)
133	Colo silty clay loam, 0 to 2 percent slopes (where drained)
158	Dorchester silt loam, 0 to 2 percent slopes
162B	Downs silt loam, 2 to 5 percent slopes
462B	Downs silt loam, benches, 2 to 5 percent slopes
163B	Fayette silt loam, 2 to 5 percent slopes
463B	Fayette silt loam, benches, 2 to 5 percent slopes
978	Festina silt loam, 0 to 2 percent slopes
98	Huntsville silt loam, 0 to 2 percent slopes
444B	Jacwin loam, 2 to 5 percent slopes (where drained)
1212	Kennebec silt loam, 0 to 2 percent slopes
83B	Kenyon loam, 2 to 5 percent slopes
110	Lamont fine sandy loam, 0 to 2 percent slopes
110B	Lamont fine sandy loam, 2 to 5 percent slopes
225	Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes
226	Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes
408B	Olin fine sandy loam, 2 to 5 percent slopes
471	Oran loam, 0 to 2 percent slopes (where drained)
930	Orion silt loam, 0 to 2 percent slopes (where protected from flooding)
930B	Orion silt loam, 2 to 5 percent slopes (where protected from flooding)
480B	Orwood silt loam, 2 to 5 percent slopes
489	Ossian silt loam, 0 to 2 percent slopes (where drained)
589	Otter silt loam, 0 to 2 percent slopes (where drained and protected from flooding)
589+	Otter silt loam, overwash, 0 to 2 percent slopes (where drained and protected from flooding)
487B	Otter-Worthen silt loams, 1 to 4 percent slopes (where drained and protected from flooding)
977	Richwood silt loam, 0 to 2 percent slopes
213B	Rockton loam, 30 to 40 inches to limestone, 2 to 5 percent slopes
214B	Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes
826	Rowley silt loam, 0 to 2 percent slopes
177	Saude loam, 0 to 2 percent slopes
177B	Saude loam, 2 to 5 percent slopes
485	Spillville loam, 0 to 2 percent slopes
120B	Tama silt loam, 2 to 5 percent slopes
323B	Terril loam, sandy substratum, 2 to 5 percent slopes
777	Wapsie loam, 0 to 2 percent slopes
777B	Wapsie loam, 2 to 5 percent slopes
178	Waukee loam, 0 to 2 percent slopes
714B	Winneshiek loam, 20 to 30 inches to limestone, 2 to 5 percent slopes
981B	Worthen silt loam, 2 to 5 percent slopes

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

According to the 1977 State of Iowa Annual Farm Census, 258,400 acres in Clayton County is used for cultivated crops and 84,600 acres for pasture. Corn, oats, legume-grass hay, and soybeans are the main crops. The paragraphs that follow describe the management concerns affecting the use of the soils in the county for crops and pasture.

Soil erosion is the major problem on more than 85 percent of the cropland and pasture in the county. Measures that control erosion are needed on Backbone, Bassett, Chelsea, Downs, Dubuque, Exette, Fayette, Frankville, Goss, Kenyon, Lamont, Lilah, Lindley, Luana, Marlean, Mottland, Nordness, Olin, Orwood, Rockton, Sparta, Tama, and Winneshiek soils.

Loss of the surface layer through erosion reduces the productivity of soils and results in sedimentation in streams. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils having a subsoil that is low in fertility, such as Bassett and Kenyon soils, and on soils having a layer in or below the subsoil that restricts the root zone. An example of this kind of layer is the bedrock underlying Backbone, Nordness, Rockton, and Winneshiek soils. Erosion also reduces the productivity of soils that tend to be droughty, such as Chelsea, Lilah, and Sparta soils. Control of erosion helps to maintain the productivity of the soils and improves the quality of water for municipal use, for recreation, and for fish and other kinds of wildlife by minimizing the pollution of streams.

Preparing a good seedbed and tilling are difficult on severely eroded soils because the original friable silt loam surface soil has been eroded away. For example, the exposed silty clay loam subsoil of the severely eroded Fayette soils is hard and cloddy after it has been worked when wet.

Measures that control erosion provide a protective plant cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface can reduce soil losses to an amount that will not decrease the productive capacity of

the soils. On livestock farms, where part of the acreage is hayland, including grasses and legumes in the cropping sytem not only provides nitrogen and improves tilth for the following crops but also helps to control erosion on the more sloping soils.

A system of conservation tillage that leaves crop residue on the surface is effective in controlling erosion. Following are examples of the major kinds of conservation tillage systems. No-tillage is a system in which the seedbed is prepared and the seed planted in one operation. The surface is disturbed only in the immediate area of the planted seed row. A protective cover of crop residue is left on at least 90 percent of the surface. Strip-till or till-plant also is a system in which the seedbed is prepared and the seed planted in one operation. Tillage is limited to a strip not wider than one-third of the row. A protective cover of crop residue is left on two-thirds of the surface. Chisel-disk or rotary tillage is a system in which the soil is loosened throughout the field and part of the crop residue is incorporated into the soil. Preparing the seedbed and planting may be one or separate operations. Conservation tillage is effective only if the amount of crop residue left on the surface after planting is enough to control erosion.

Terraces and diversions reduce the length of slopes and thus the runoff rate and the risk of erosion. They are most practical on deep, well drained soils that have long, uniform slopes. In many areas Downs, Fayette, and Tama soils are well suited to terracing. Other soils are less suitable for terraces and diversions because slopes are irregular or are too steep or because bedrock is within a depth of 40 inches. Terracing is not practical on Chelsea, Lilah, Sparta, and other soils that have short, irregular slopes and are coarse textured or moderately coarse textured. On these soils a cropping system that provides a substantial plant cover and a system of conservation tillage that leaves crop residue on the surface are effective in controlling erosion.

Contour farming and contour stripcropping help to control erosion on many soils in the county. They are most effective in areas where slopes are smooth and uniform, including most areas of Downs, Fayette, and Tama soils.

Soil blowing is a hazard on the sandy Chelsea and Sparta soils and on the organic Palms soils. It can be controlled by a plant cover, surface mulch, or tillage methods that keep the surface rough. On the organic soils it can be controlled by windbreaks of suitable shrubs, such as Tatarian honeysuckle or autumn-olive.

Controlling erosion is difficult on Bassett, Kenyon, and Olin soils because the loamy upper part of these soils is more rapidly permeable than the glacial till in the lower part of the subsoil and in the substratum. Water tends to move more rapidly through the upper part and then tends to accumulate at the point where the loamy material comes in contact with the till. As a result, hillside seepage can occur during wet periods. On these soils a combination of terracing and tiling is needed. Also, gully-control structures and grassed waterways are needed in the watercourses.

Soil drainage is a minor management concern in Clayton County. Very poorly drained to somewhat poorly drained soils make up less than 10 percent of the total acreage.

The design of both surface and subsurface drainage systems varies with the kind of soil. Surface drains and measures that control the runoff from the slopes at the higher elevations are needed in most areas of the somewhat poorly drained and poorly drained soils used for intensive row cropping. The drains should be more closely spaced in the moderately slowly permeable soils than in the more rapidly permeable soils.

Organic soils oxidize and subside when their pore space is filled with air. As a result, special drainage systems are needed to control the depth and the period of drainage in the Palms soils. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimizes the oxidation and the subsidence of these soils.

Soil fertility is affected by the supply of available phosphorus and potassium in the subsoil, by reaction, and by the content of organic matter. The supply of available phosphorus and potassium is low or very low in most of the soils in the county. Fayette soils, however, have a high supply of available phosphorus, and Downs soils have a medium supply.

Most of the upland soils have an acid subsoil. Applications of ground limestone are needed to raise the pH level sufficiently for alfalfa and other crops to grow well. The poorly drained Clyde and somewhat poorly drained Floyd soils generally are neutral.

In most of the medium textured, well drained upland soils that formed under forest vegetation, the content of organic matter is about 1 to 2 percent in the surface layer. In the eroded soils, however, it generally is less than 1 percent. In the medium textured, well drained soils that formed under grasses and trees, such as Downs soils, the content is about 2 to 3 percent. It is about 3 to 4 percent in the medium textured soils that formed under grasses, such as Kenyon and Tama soils, generally is less than 1 percent in the coarse textured upland soils, and is 7 to 11 percent in the poorly drained or very poorly drained upland soils, such as Calamine and Clyde soils. In the very poorly drained, organic Palms soils, it is more than 30 percent.

The soils that formed in alluvium on bottom land are neutral or mildly alkaline. They generally have a low or very low supply of available phosphorus and potassium in the subsoil. The content of organic matter is about 1 percent in the Dorchester soils and 5 to 7 percent in the Otter soils.

Applications of lime and fertilizer should be based on the results of soil tests, on the needs of intended crop,

and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts needed.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth generally are high in content of organic matter and are granular and porous.

Most of the upland soils in the county have a light colored surface layer that is moderately low or low in content of organic matter. Generally, the structure of the surface layer is weak, and a surface crust forms during periods of intense rainfall. The crust is hard when dry. It reduces the rate of water infiltration and increases the runoff rate. Regularly adding crop residue, manure, and other organic material improves soil structure and helps to prevent crusting.

Fall plowing generally is not desirable on the soils in this county because it increases the susceptibility to soil blowing. It also increases the susceptibility to water erosion during periods of snowmelt and spring runoff.

Most of the permanent pastures in the county support bluegrass, but some support a grass-legume mixture, such as alfalfa and bromegrass. Most of the bluegrass pastures are not used as cropland because the soils are too steep for cultivation. Some pastures have been renovated and planted to birdsfoot trefoil or crownvetch.

Forage production can be enhanced by planting warm-season grasses, including switchgrass, big bluestem, and indiangrass. The management needed on established stands includes applications of fertilizer, control of weeds and brush, rotation and deferred grazing in a full-season grazing system, proper stocking rates, and adequate livestock watering facilities. Erosion is a severe hazard if the protective plant cover is destroyed when the more sloping areas of pasture and hayland are renovated. If cultivated crops are grown prior to seeding, soil losses can be reduced by contour farming, grassed waterways, and a system of conservation tillage that leaves crop residue on the surface. Interseeding grasses and legumes into the existing sod eliminates the need for destroying the plant cover during seedbed preparation.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production. There are no class VIII soils in Clayton County.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

woodland management and productivity

About 110,000 acres in Clayton County, or more than one-fifth of the total acreage, is woodland. The trees are used for wood products that are either sold off the farm or used on the farm. Also, they help to control erosion and provide food and cover for wildlife.

Trees formerly covered nearly all of Clayton County, except for the areas between Garnavillo and Monona and the areas in the southwestern part that were covered by prairie grasses. The early settlers valued the trees as a source for building material and fuel. They harvested the best trees and left the less desirable ones. Gradually, the less desirable trees dominated the woodland. Some of the wooded soils, notably Dubuque, Exette, Fayette, and Lindley soils, were cleared for farming. Many of the areas of these soils are severely eroded. Replanting of suitable trees is needed before longtime effective use can be made of these areas.

Of the six soil associations described under the heading "General soil map units," the Fayette-Nordness-Rock outcrop association has the largest proportion of woodland. On the other associations the trees are in a few woodlots or are scattered along drainageways, in fence rows, and on farmsteads. In many of the wooded areas of the Fayette-Nordness-Rock outcrop association, the soils are unsuitable for cultivation because they are too steep or are shallow to limestone bedrock. Many cropped areas are bordered by woods, and most pastured areas support some trees. Much of the steep or very steep land bordering the Mississippi, Turkey, and Volga Rivers is not suited to crops and is poorly suited to pasture. In these areas the stands of woodland are extremely important because they help to control erosion.

Although the demand for walnut logs is significant, the demand for lumber generally is not great in the county. Several sawmills are active in the county, but they commonly are operated on a part-time basis. Most of the logs for the sawmills are obtained by selectively cutting on a number of sites rather than by harvesting an entire tract.

Good management helps to keep native woodland productive. It includes measures that protect the woodland from livestock and fire; group selective cutting, thinning, and planting; and weeding. Many of the tracts have been used for grazing and have been poorly managed. Grazing damages a wooded area as much as overcutting or burning. The grazing animals trample the soil and increase the susceptibility to erosion. Browsing damages or kills the young trees and the undergrowth. Wooded areas generally are not suitable for grazing because they do not provide enough forage.

The management of a wooded area depends on its present condition and the kinds of trees to be grown. The objective of woodland management is to attain sustained production by cutting only the amount of wood that the stand produces in a given period. This cutting can be done each year or every 5 to 10 years. Some areas wooded with hardwoods are in such poor condition that they should be planted to the more valuable conifers. Before the conifers are planted, the competing trees and shrubs should be removed by mowing or by spraying with a chemical brush killer.

The factors that affect the use of soils for woodland are somewhat different from and less restrictive than those that affect the use of the soils for cultivated crops. This soil survey can help the owner of a wooded tract to identify the soils that are most likely to be productive as woodland. If the soil is likely to be productive, extensive management is justified. It is not justified, however, if the soil is poorly suited to woodland. Some of the factors that affect woodland management are described in the following paragraphs.

Moisture.—The growth of trees is directly related to the available water capacity of the soil. The available water capacity is determined mainly by the slope, the depth, the texture, the permeability, and the internal drainage. It is limited in Chelsea, Nordness, and Sparta soils.

Aspect, or direction of exposure.—The exposure of a site affects the rate of tree growth. Trees generally grow better on slopes facing north and east and on gently sloping or nearly level valley flats and broad ridgetops than on slopes facing south or west. Some soils are on

long, steep slopes that have various exposures. Examples are some of the Fayette and Nordness soils.

Soil reaction and soil fertility.—These factors somewhat affect the suitability and growth of different species of trees. For example, walnut and locust trees grow best on neutral or slightly calcareous soils. Pine trees grow best in slightly acid soil. Most species of pine, especially the native ones, grow poorly on soils that have a high content of lime. In contrast, hardwoods and eastern redcedar commonly grow well on those soils. Caneek and Dorchester soils have a high content of lime in the upper 2 to 3 feet. Most of the other bottom land soils in the county are neutral. Hardwoods should not be planted on eroded or depleted soils or on formerly cultivated soils, whereas pine trees grow fairly well on those soils.

Local offices of the Soil Conservation Service can help woodland managers to determine which soils are suitable for trees, the best land use for wooded areas, and the kinds of management needed. State foresters can assist in developing plans for managing new or existing stands.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on the soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, keep snow from blowing off the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various

soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

Every town in Clayton County has at least one local park. Many county parks are throughout the survey area. Pikes Peak State Park is near McGregor.

In rural areas opportunities for hunting, fishing, and other forms of outdoor recreation are provided by rivers and creeks, especially the Mississippi River. Many of the small creeks, in addition to part of the Turkey River, are spring fed and are cold enough to be stocked with trout. Trees and limestone bluffs are along many of the rivers and creeks. In the fall the colorful leaves of the trees attract thousands of tourists. Clayton County is commonly called "the Little Switzerland of northeast Iowa."

The county provides habitat for many kinds of wildlife. These wildlife species enhance the opportunities for recreation. The numerous white-tailed deer, for example, are hunted throughout the county.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed

performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary

landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as calcium carbonate. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 or 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams and by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or*high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*18*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that have an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Haplaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*17*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*18*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Ankeny series

The Ankeny series consists of well drained, rapidly permeable soils on low stream benches and foot slopes. These soils formed in loamy and sandy alluvium. The native vegetation was prairie grasses. Slope ranges from 0 to 2 percent.

Ankeny soils are similar to Spillville soils and commonly are adjacent to Spillville and Terril soils. Their A horizon contains more sand and less clay than that of the adjacent soils. Spillville soils are on bottom land. Terril soils are on foot slopes and alluvial fans.

Typical pedon of Ankeny fine sandy loam, 0 to 2 percent slopes, in a cultivated field; 1,200 feet west and 1,265 feet north of the southeast corner of sec. 23, T. 93 N., R. 5 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure; very friable; slightly acid; abrupt smooth boundary.

A12—8 to 28 inches; black (10YR 2/1) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

A13—28 to 36 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

B2—36 to 48 inches; dark brown (10YR 3/3) loamy fine sand; weak fine subangular blocky structure; very friable; some clay bridging between sand grains; neutral; clear smooth boundary.

C—48 to 60 inches; brown (10YR 4/3) fine sand; single grained; loose; neutral.

The solum ranges from 40 to 60 inches in thickness. The A and B horizons are neutral or slightly acid. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). It ranges from 24 to 36 inches in thickness. The B2 horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. The depth to loamy fine sand ranges from 36 to 42 inches. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is fine sand or loamy fine sand.

Arenzville series

The Arenzville series consists of well drained and moderately well drained, moderately permeable soils on narrow bottom land, on alluvial fans, and in upland drainageways. These soils formed in stratified, silty alluvium 20 to 40 inches deep over a buried soil (fig. 17).

Figure 17.—An area of Arenzville silt loam along a streambank. This soil formed in stratified light colored alluvium over a dark buried surface layer.

The native vegetation was deciduous trees. Slope ranges from 0 to 5 percent.

Arenzville soils are similar to Chaseburg soils and commonly are adjacent to Chaseburg, Huntsville, Orion, and Worthen soils. Chaseburg soils do not have a buried horizon. The A horizon in Huntsville and Worthen soils is darker than that in the Arenzville soils. Orion soils have gray mottles within a depth of 20 inches and are somewhat poorly drained. Chaseburg and Huntsville soils are in landscape positions similar to those of the Arenzville soils. Orion soils are in the lower lying areas. Worthen soils are on foot slopes above the Arenzville soils.

Typical pedon of Arenzville silt loam, 0 to 2 percent slopes, in a permanent pasture; 924 feet north and 25 feet east of the center of sec. 25, T. 92 N., R. 6 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam that has thin very dark grayish brown (10YR 3/2) strata; pale brown (10YR 6/3) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

C1—7 to 18 inches; stratified dark grayish brown (10YR 4/2), brown (10YR 5/3), and very dark grayish brown (10YR 3/2) silt loam; weak medium platy structure parting to weak fine subangular blocky; friable; neutral; clear smooth boundary.

C2—18 to 28 inches; stratified grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) silt loam that has thin brown (10YR 5/3) strata; weak medium and fine platy structure parting to weak fine subangular blocky; friable; neutral; abrupt smooth boundary.

Ab—28 to 45 inches; black (10YR 2/1) silt loam; weak fine granular structure; friable; neutral; clear smooth boundary.

C—45 to 60 inches; very dark grayish brown (10YR 3/2) loam; massive; friable; neutral.

The depth to the Ab horizon ranges from 20 to 40 inches. The 10- to 40-inch control section generally ranges from 10 to 18 percent clay. In some pedons, however, the clay content in the Ab horizon is more than 18 percent. The soils typically are neutral or mildly alkaline throughout, but in some pedons the Ap horizon is slightly acid. The color, arrangement, and thickness of all horizons varies because of the source of the sediments and the method of deposition.

The Ap or A1 horizon typically is dark grayish brown (10YR 4/2), but some strata have value of 3 to 5 and chroma of 3. The C horizon has hue of 10YR, value of 3 to 6, and chroma of 2 or 3. The Ab horizon is black (10YR 2/1) or very dark brown (10YR 2/2). Some pedons have thin lenses of material coarser than silt loam within a depth of 40 inches.

Atterberry series

The Atterberry series consists of somewhat poorly drained, moderately permeable soils on broad upland ridges. These soils formed in loess. The native vegetation was mixed grasses and trees. Slope ranges from 1 to 3 percent.

Atterberry soils are similar to Canoe soils and commonly are adjacent to Downs and Tama soils. Canoe soils are formed in alluvium and contain more sand throughout than the Atterberry soils. Downs and Tama soils are well drained and are on convex ridges and side slopes below the Atterberry soils. Also, the A horizon in Tama soils is thicker and darker than that in the Atterberry soils.

Typical pedon of Atterberry silt loam, 1 to 3 percent slopes, 210 feet north and 40 feet west of the southeast corner of sec. 33, T. 91 N., R. 2 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A2—8 to 12 inches; grayish brown (10YR 5/2) silt loam, pale brown (10YR 6/3) dry; dark grayish brown (10YR 4/2) coatings on faces of peds; weak fine platy structure; friable; slightly acid; clear smooth boundary.

B1—12 to 17 inches; brown (10YR 5/3) silt loam; few fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; few light gray (10YR 7/2) silt coatings; strongly acid; clear smooth boundary.

B21t—17 to 25 inches; grayish brown (10YR 5/2) silty clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; thin discontinuous very dark grayish brown (10YR 3/2) clay films; white (10YR 8/1) silt coatings; few dark concretions (manganese oxide); strongly acid; clear smooth boundary.

B22t—25 to 37 inches; grayish brown (10YR 5/2) silty clay loam; many coarse prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to weak fine subangular blocky; friable; thin discontinuous very dark grayish brown (10YR 3/2) clay films on faces of peds and clay flows in root channels; many dark concretions (manganese oxide); strongly acid; clear smooth boundary.

B3t—37 to 46 inches; grayish brown (10YR 5/2) silt loam; many coarse prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; thin discontinuous very dark grayish brown (10YR 3/2) clay flows; many dark concretions (manganese oxide); medium acid; clear smooth boundary.

C—46 to 60 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) silt loam; massive; friable; slightly acid.

The thickness of the solum ranges from 40 to 60 inches. The Ap horizon is very dark gray (10YR 3/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The A2 horizon typically is 3 to 8 inches thick, but in some pedons it is partly incorporated into the Ap horizon. The B horizon is medium acid or strongly acid. The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is silty clay loam in which the content of clay ranges from 28 to 34 percent. The B3t horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is silt loam or silty clay loam. The C horizon is medium acid to neutral.

Backbone series

The Backbone series consists of somewhat excessively drained soils. Permeability of these soils is moderately rapid in the upper part and moderately slow in the lower part of the subsoil. These soils are on convex ridges and side slopes in the uplands. They formed in 20 to 40 inches of moderately coarse textured sediments and in a thin layer of limestone residuum. The native vegetation was mixed prairie grasses and trees. Slope ranges from 2 to 14 percent.

Backbone soils are similar to Lamont soils and commonly are adjacent to Chelsea, Lamont, Marlean, and Nordness soils. Chelsea and Lamont soils do not have limestone bedrock within a depth of 60 inches. Also, Chelsea soils are sandy throughout. Marlean soils formed in loamy material over limestone residuum. Nordness soils have limestone bedrock within a depth of 20 inches. Chelsea, Lamont, and Marlean soils are in landscape positions similar to those of the Backbone soils. Nordness soils are in the more sloping areas.

Typical pedon of Backbone fine sandy loam, 2 to 5 percent slopes, in a cultivated field; 2,346 feet east and 396 feet south of the northwest corner of sec. 16, T. 92 N., R. 5 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; slightly acid; abrupt smooth boundary.

B1—8 to 12 inches; brown (10YR 4/3) fine sandy loam; dark grayish brown (10YR 4/2) coatings on faces of peds; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

B21—12 to 17 inches; brown (10YR 4/3) fine sandy loam; weak medium and fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B22t—17 to 22 inches; dark yellowish brown (10YR 4/4) sandy loam; brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; friable; thin discontinuous very dark grayish brown (10YR 3/2) clay films; neutral; abrupt smooth boundary.

IIB23t—22 to 27 inches; strong brown (7.5YR 5/6) clay; moderate fine subangular and angular blocky structure; very firm; nearly continuous dark grayish brown (10YR 4/2) clay films; slightly acid; abrupt smooth boundary.

IIR—27 inches; hard, fractured limestone bedrock.

The thickness of the solum, or the depth to bedrock, ranges from 20 to 40 inches. The A1 or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. Some pedons have an A2 horizon, which is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 5/3) and is 2 to 4 inches thick. The IIB23t horizon ranges from clay loam to clay and is 2 to 5 inches thick.

Bassett series

The Bassett series consists of moderately well drained, moderately permeable soils on convex ridges and side slopes in the uplands. These soils formed in loamy sediments and in the underlying glacial till. The native vegetation was mixed grasses and trees. Slope ranges from 2 to 9 percent.

Bassett soils are similar to Orwood soils and commonly are adjacent to Clyde, Floyd, Lilah, Oran, and Winneshiek soils. Orwood soils do not have coarse fragments throughout the solum. Clyde and Floyd soils are grayer in the upper part of the B horizon than the Bassett soils and have a more friable IIB horizon. They are in or along drainageways below the Bassett soils. Lilah soils formed in sediments that are coarser textured than those in which the Bassett soils formed. They are on stream benches and in outwash areas on uplands. Oran soils are on broad ridges above the Bassett soils. Their B horizon is grayer in the upper part than that of the Bassett soils. Winneshiek soils are underlain by limestone bedrock at a depth of 20 to 30 inches. They are on side slopes below the Bassett soils.

Typical pedon of Bassett loam, 2 to 5 percent slopes, in a cultivated field; 790 feet north and 885 feet east of the southwest corner of sec. 30, T. 91 N., R. 5 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A2—8 to 14 inches; brown (10YR 4/3) loam, grayish brown (10YR 5/2) dry; few very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium platy structure parting to weak fine subangular blocky; friable; strongly acid; clear smooth boundary.

B1—14 to 20 inches; yellowish brown (10YR 5/6) loam; brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

IIB21t—20 to 27 inches; yellowish brown (10YR 5/6) loam; grayish brown (10YR 5/2) coatings on faces of peds; common fine distinct brown (10YR 5/3) mottles; moderate fine subangular blocky structure; firm; thin discontinuous brown (7.5YR 4/4) clay films; strongly acid; clear smooth boundary.

IIB22t—27 to 39 inches; yellowish brown (10YR 5/6) loam; many medium distinct grayish brown (10YR 5/2) and brown (10YR 5/3) mottles; moderate fine subangular blocky structure; firm; few reddish concretions (iron oxide); strongly acid; clear smooth boundary.

IIB3t—39 to 53 inches; mottled yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) loam; weak fine prismatic structure parting to weak fine subangular blocky; firm; thin discontinuous brown (7.5YR 4/4) clay films; medium acid; clear smooth boundary.

IIC—53 to 60 inches; mixed yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) loam; few fine distinct strong brown (7.5YR 5/6) mottles; massive; firm; few reddish concretions (iron oxide); strong effervescence; mildly alkaline.

The solum ranges from 45 to 60 inches in thickness. The loamy sediments are 14 to 21 inches thick. A stone line commonly separates the loamy sediments from the glacial till.

The A1 or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. The A2 horizon is brown (10YR 4/3 or 5/3). It generally is 2 to 8 inches thick, but it does not occur in some cultivated areas. The upper part of the B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The IIB horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6 and has mottles with lower chroma. It typically is loam, but the range includes clay loam and sandy clay loam.

Bertrand series

The Bertrand series consists of well drained soils that are moderately permeable in the upper part and moderately rapidly permeable in the substratum. These soils are on stream benches. They formed in silty alluvium underlain by stratified alluvium. The native vegetation was deciduous trees. Slope ranges from 0 to 2 percent.

These soils are taxadjuncts to the Bertrand series because the underlying stratified material lacks the development characteristic of a solum. This difference, however, does not significantly affect the use or behavior of the soils.

Bertrand soils are similar to Festina soils and commonly are adjacent to those soils and to Canoe and Canoe Variant soils. Festina soils commonly have an A horizon that is thicker than that of the Bertrand soils and have a less distinct A2 horizon. Their position on the landscape is similar to that of the Bertrand soils. The somewhat poorly drained Canoe and Canoe Variant soils are in the lower lying areas on the stream benches. The upper part of their B horizon is grayer than that of the Bertrand soils.

Typical pedon of Bertrand silt loam, 0 to 2 percent slopes, in a cultivated field; 1,020 feet north and 990 feet east of the center of sec. 6, T. 92 N., R. 4 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry, dark grayish brown (10YR 4/2) kneaded; few very dark grayish brown (10YR 3/2) coatings on faces of peds; weak very fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A21—8 to 13 inches; brown (10YR 5/3) silt loam, pale brown (10YR 6/3) dry; dark grayish brown (10YR 4/2) coatings on faces of peds; weak thin platy structure; friable; slightly acid; clear smooth boundary.

A22—13 to 17 inches; yellowish brown (10YR 5/4) silt loam, light yellowish brown (10YR 6/4) dry; brown (10YR 4/3) coatings on faces of peds; weak thin platy structure parting to weak fine subangular blocky; friable; slightly acid; clear smooth boundary.

B21t—17 to 26 inches; yellowish brown (10YR 5/6) silt loam; brown (10YR 4/3) coatings on faces of peds; weak medium and fine angular blocky structure; friable; thin discontinuous silt coatings, light gray (10YR 7/1) dry; dark brown (7.5YR 3/2) clay films; medium acid; clear smooth boundary.

B22t—26 to 32 inches; yellowish brown (10YR 5/4 and 5/6) silt loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak medium angular blocky structure; friable; thin discontinuous light gray (10YR 7/1) silt coatings; dark brown (7.5YR 3/2) clay films; medium acid; clear smooth boundary.

B31t—32 to 44 inches; yellowish brown (10YR 5/4) silt loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak medium prismatic structure; friable; thin discontinuous brown (10YR 4/3) clay films; medium acid; clear smooth boundary.

B32—44 to 52 inches; yellowish brown (10YR 5/4) silt loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak medium prismatic structure; friable; medium acid; clear smooth boundary.

IIC—52 to 60 inches; yellowish brown (10YR 5/4) stratified silt loam and loamy sand; massive; friable; medium acid.

The thickness of the solum ranges from 40 to 60 inches. These soils formed in silty sediments 40 to 60

inches deep over stratified alluvium. The content of sand in the solum ranges from 10 to 25 percent.

The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 2 to 4 inches thick. The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 5/3). The A2 horizon is 4 to 12 inches thick. The B22t horizon is silt loam or silty clay loam in which the content of clay ranges from 20 to 30 percent. The B22t and B31t horizons have hue of 10YR, value of 4 to 6, and chroma of 3 to 6. The IIC horizon is stratified silt loam, sandy loam, or loamy sand.

Calamine series

The Calamine series consists of poorly drained and very poorly drained soils that are moderately permeable in the upper part and very slowly permeable in the lower part. These soils are on foot slopes or benches below areas where limestone crops out. They formed in 20 to 30 inches of moderately fine textured material and in the underlying material weathered from clayey shale. The native vegetation was water-tolerant grasses. Slope ranges from 1 to 3 percent.

These soils are taxadjuncts to the Calamine series because they do not have an argillic horizon, contain more sand in the upper part of the solum than is defined as the range for the series, and have a calcareous A horizon. These differences, however, do not significantly affect the use or behavior of the soils.

Calamine soils commonly are adjacent to Jacwin and Marlean soils. The somewhat poorly drained Jacwin soils are higher on the landscape than the Calamine soils. Also, the upper part of their B horizon is browner. Marlean soils are underlain by limestone bedrock. They are on convex side slopes below the Calamine soils.

Typical pedon of Calamine loam, 1 to 3 percent slopes, in a permanent pasture; 66 feet east and 1,400 feet north of the southwest corner of sec. 23, T. 92 N., R. 6 W.

A11—0 to 6 inches; black (N 2/0) loam, black (10YR 2/1) dry; weak fine granular structure; friable; strong effervescence; mildly alkaline; clear smooth boundary.

A12—6 to 15 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; weak fine granular structure; friable; strong effervescence; mildly alkaline; clear smooth boundary.

B1g—15 to 20 inches; dark gray (5Y 4/1) clay loam; discontinuous black (5Y 2/1) coatings on faces of peds; few fine distinct olive gray (5Y 4/2) mottles; weak fine subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

B2g—20 to 27 inches; olive gray (5Y 4/2 and 5/2) clay loam; few fine distinct olive (5Y 5/4) and yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; friable; neutral; abrupt wavy boundary.

IIB3g—27 to 36 inches; greenish gray (5GY 6/1) and light olive brown (2.5Y 5/6) silty clay; weak fine angular blocky structure; extremely firm; mildly alkaline; clear smooth boundary.

IICr—36 to 60 inches; greenish gray (5GY 6/1) and olive yellow (2.5Y 6/8) silty clay shale; massive; extremely firm; strong effervescence; mildly alkaline.

The solum ranges from 30 to 50 inches in thickness. It is neutral or mildly alkaline. The depth to carbonates ranges from 0 to 30 inches. The depth to material weathered from clayey shale ranges from 20 to 30 inches.

The A horizon typically is loam and clay loam but in some pedons is silty clay loam or silt loam high in content of sand. It is 15 to 24 inches thick. The B2 horizon has hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is clay loam, silty clay loam, or sandy clay loam. In some pedons strata of sandy loam or loamy sand as much as 8 inches thick are between the moderately fine textured material and the material weathered from clayey shale. The Cr horizon is silty clay shale or clay shale. In some pedons it is interbedded with a small amount of fractured limestone.

Caneek series

The Caneek series consists of somewhat poorly drained and poorly drained, moderately permeable soils on bottom land. These soils formed in calcareous, stratified recent alluvium. The native vegetation was deciduous trees. Slope ranges from 0 to 2 percent.

Caneek soils commonly are adjacent to Dorchester, Medary Variant, and Zwingle soils. The moderately well drained Dorchester soils are in the higher lying areas on the bottom land. They are browner in the upper part than the Caneek soils. Medary Variant and Zwingle soils have a dominantly clayey B horizon. They are on high stream benches.

Typical pedon of Caneek silt loam, 0 to 2 percent slopes, in a permanent pasture; 356 feet north and 594 feet west of the center of sec. 22, T. 94 N., R. 3 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; weak thin platy structure; friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—6 to 16 inches; dark grayish brown (10YR 4/2) silt loam that has thin dark gray (10YR 4/1) and brown (10YR 5/3) strata; massive but tending to be platy because of geologic deposition; friable; common fine prominent reddish brown (5YR 4/4) mottles; common dark concretions (manganese oxide); slight effervescence; mildly alkaline; clear smooth boundary.

C2—16 to 32 inches; stratified dark grayish brown (10YR 4/2), dark gray (10YR 4/1), and very dark grayish brown (10YR 3/2) silt loam; massive but tending to be platy because of geologic deposition; friable; common fine prominent reddish brown (5YR 4/4) mottles; dark reddish concretions (iron and manganese oxide); slight effervescence; mildy alkaline; abrupt wavy boundary.

IIAb—32 to 50 inches; dominantly black (10YR 2/1) silt loam, very dark gray (10YR 3/1) in the lower part; weak very fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

IIBb—50 to 60 inches; dark gray (10YR 4/1) silt loam; weak medium subangular blocky structure; friable; neutral.

The depth to the IIAb horizon ranges from 20 to 36 inches. Free carbonates are throughout the C horizon but are not evident in the IIAb horizon. The color, arrangement, and thickness of all horizons vary because of the source of the sediments.

The C horizon is dominantly dark grayish brown (10YR 4/2) or dark gray (10YR 4/1) but generally has thin gray (10YR 5/1), very dark grayish brown (10YR 3/2), or brown (10YR 5/3) strata. It has distinct or prominent mottles. It is mildly or moderately alkaline. It is dominantly silt loam but in some pedons has thin strata of loam. The IIAb horizon is silt loam or silty clay loam, generally more than 10 inches thick. It is neutral or mildly alkaline.

Canoe series

The Canoe series consists of somewhat poorly drained, moderately permeable soils on low stream benches. These soils formed in silty alluvium. The native vegetation was mixed grasses and trees. Slope ranges from 0 to 2 percent.

These soils are taxadjuncts to the Canoe series because they do not have an argillic horizon. This difference, however, does not significantly affect the use or behavior of the soils.

Canoe soils are similar to Atterberry and Canoe Variant soils and commonly are adjacent to Bertrand, Festina, and Rowley soils. Atterberry soils have a lower content of sand than the Canoe soils and formed in loess. The A2 horizon of Canoe Variant soils is thicker and lighter colored than that of the Canoe soils. The well drained Bertrand and Festina soils are in the higher lying areas on the stream benches. The upper part of their B horizon is browner than that of the Canoe soils. Rowley soils are in positions on the landscape similar to those of the Canoe soils. Their A1 horizon is thicker than that of the Canoe soils.

Typical pedon of Canoe silt loam, 0 to 2 percent slopes, in a cultivated field; 430 feet east and 93 feet south of the northwest corner of sec. 36, T. 95 N., R. 6 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; weak very fine and fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A2—8 to 14 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few fine distinct brown (10YR 5/3) and few fine faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B1—14 to 20 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; friable; few dark concretions (manganese oxide); strongly acid; clear smooth boundary.

B21—20 to 29 inches; mottled grayish brown (2.5Y 5/2), olive yellow (2.5Y 6/6), and light olive brown (2.5Y 5/4) silt loam; weak medium and fine subangular blocky structure; friable; few dark concretions (iron and manganese oxide); strongly acid; clear smooth boundary.

B22—29 to 39 inches; mottled light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/6) silt loam; weak medium subangular blocky structure; friable; common dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

B3—39 to 47 inches; light brownish gray (2.5Y 6/2) silt loam; weak medium prismatic structure; friable; common dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

C—47 to 60 inches; gray (5Y 5/1) and light olive gray (5Y 6/2) silt loam; massive; common dark concretions (iron and manganese oxide); friable; strongly acid.

The thickness of the solum typically is about 47 inches but ranges from 40 to 60 inches. The A1 horizon is very dark brown (10YR 2/2) or very dark gray (10YR 3/1). It is 6 to 9 inches thick. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The A2 horizon generally is 4 to 12 inches thick, but in some pedons it is partly incorporated into the Ap horizon. The B2 horizon is silt loam or silty clay loam. It has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. Thin strata of sand are between depths of 40 and 60

inches in some pedons. The B and C horizons are medium acid or strongly acid.

Canoe Variant

The Canoe Variant consists of somewhat poorly drained, moderately permeable soils on stream benches. These soils formed in silty alluvium. The native vegetation was deciduous trees. Slope ranges from 0 to 2 percent.

Canoe Variant soils are similar to Canoe soils and commonly are adjacent to Bertrand soils. The A1 horizon of Canoe soils is thicker than that of the Canoe Variant soils. Also, the A2 horizon is less distinct. The well drained Bertrand soils are in the higher lying areas on the stream benches. The upper part of their B horizon is browner than that of the Canoe Variant soils.

Typical pedon of Canoe Variant silt loam, 0 to 2 percent slopes, in a cultivated field; 1,100 feet east and 24 feet north of the center of sec. 6, T. 92 N., R. 4 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A21—6 to 10 inches; grayish brown (10YR 5/2) silt loam, pale brown (10YR 6/3) dry; few dark grayish brown (10YR 4/2) coatings on faces of peds; weak thin platy structure parting to weak fine subangular blocky; friable; few dark concretions (manganese and iron oxide); medium acid; clear smooth boundary.

A22—10 to 15 inches; light brownish gray (10YR 6/2) silt loam, light gray (10YR 7/2) dry; few grayish brown (10YR 5/2) coatings on faces of peds; common fine distinct brown (7.5YR 4/4) mottles; weak thin platy structure parting to weak fine subangular blocky; friable; thin discontinuous silt coatings, light gray (10YR 7/1) dry; medium acid; clear smooth boundary.

B21t—15 to 25 inches; grayish brown (10YR 5/2) silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium angular blocky structure; friable; thin discontinuous brown (7.5YR 4/4) clay films; silt coatings, light gray (10YR 7/1) dry; few dark concretions (manganese oxide); strongly acid; clear smooth boundary.

B22t—25 to 31 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium angular blocky structure; friable; thin discontinuous brown (7.5YR 4/4) clay films; silt coatings, light gray (10YR 7/1) dry; strongly acid; clear smooth boundary.

B3t—31 to 43 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) silt loam; weak medium prismatic structure; friable; thick discontinuous brown (7.5YR 4/4) clay flows in root channels; strongly acid; clear smooth boundary.

C—43 to 60 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; massive; friable; few dark concretions (manganese oxide); strongly acid.

The solum ranges from 40 to 60 inches in thickness. The A1 horizon is very dark gray (10YR 3/1), dark gray (10YR 4/1), or very dark grayish brown (10YR 3/2). It is 2 to 5 inches thick. The Ap horizon typically is dark grayish brown (10YR 4/2). The A2 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2). It is 4 to 12 inches thick. The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6, chroma of 2 or 3. It is silt loam in which the content of clay ranges from 20 to 27 percent. The C horizon is dominantly silt loam, but in some pedons strata of sandy loam, loam, and loamy sand are below a depth of 5 feet.

Chaseburg series

The Chaseburg series consists of moderately well drained, moderately permeable soils on narrow bottom land and alluvial fans and in upland drainageways. These soils formed in silty alluvium. The native vegetation was deciduous trees. Slope ranges from 0 to 5 percent.

Chaseburg soils are similar to Arenzville soils and commonly are adjacent to Arenzville, Huntsville, and Orion soils. Arenzville and Orion soils are underlain by a dark colored buried soil at a depth of 20 to 40 inches. The A horizon of Huntsville soils is darker than that of the Chaseburg soils. Arenzville and Huntsville soils are in positions on the landscape similar to those of the Chaseburg soils. Orion soils are in the lower lying areas.

Typical pedon of Chaseburg silt loam, in a pastured area of Arenzville-Chaseburg silt loams, 1 to 5 percent slopes, 660 feet east and 2,428 feet south of the northwest corner of sec. 28, T. 93 N., R. 6 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

C1—4 to 20 inches; stratified dark grayish brown (10YR 4/2), brown (10YR 5/3), and very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) kneaded; weak fine platy strata, the result of geologic deposition; friable; neutral; gradual smooth boundary.

C2—20 to 31 inches; dark grayish brown (10YR 4/2) silt loam that has very thin very dark grayish brown (10YR 3/2) strata; weak fine platy strata, the result of geologic deposition; friable; neutral; gradual smooth boundary.

C3—31 to 43 inches; dark grayish brown (10YR 4/2) silt loam that has thin black (10YR 2/1) and very dark brown (10YR 2/2) and very thin light brownish gray (10YR 6/2) strata; dark grayish brown (10YR 4/2) kneaded; weak fine platy strata, the result of geologic deposition; friable; neutral; gradual smooth boundary.

C4—43 to 60 inches; stratified dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam that has thin grayish brown (10YR 5/2) strata; weak fine platy strata, the result of geologic deposition; friable; few dark concretions (iron oxide); neutral.

The color, arrangement, and thickness of all horizons vary because of the source of the sediments and the method of deposition. The 10- to 40-inch control section ranges from 12 to 16 percent clay. The soils typically are neutral throughout, but in some pedons the Ap horizon is slightly acid.

The A1 or Ap horizon is dominantly dark grayish brown (10YR 4/2) but commonly has strata with value of 3 to 5 and chroma of 2 or 3. The C horizon dominantly has hue of 10YR, value of 3 to 6, and chroma of 2 to 4.

Chelsea series

The Chelsea series consists of excessively drained, rapidly permeable soils on uplands and high stream benches. These soils formed in eolian fine sand. The native vegetation was deciduous trees. Slope ranges from 2 to 25 percent.

Chelsea soils commonly are adjacent to Backbone, Goss, Lamont, and Lindley soils. They are in positions on the landscape similar to those of the adjacent soils. Backbone soils are underlain by limestone bedrock at a depth of 20 to 40 inches. Goss soils formed in clayey residuum of limestone. Lamont and Lindley soils contain less sand throughout the solum than the Chelsea soils. Also, Lindley soils formed in glacial till.

Typical pedon of Chelsea loamy fine sand, 5 to 14 percent slopes, in a wooded area used for pasture; 28 feet west and 2,100 feet south of the northeast corner of sec. 6, T. 94 N., R. 6 W.

A11—0 to 2 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on faces of peds; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—2 to 4 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; slightly acid; clear smooth boundary.

A21—4 to 7 inches; dark grayish brown (10YR 4/2) loamy fine sand, brown (10YR 5/3) dry; some small very dark grayish brown (10YR 3/2) streaks and pockets; single grained; loose; medium acid; clear smooth boundary.

A22—7 to 29 inches; brown (10YR 4/3) fine sand, pale brown (10YR 6/3) dry; single grained; loose; strongly acid; gradual smooth boundary.

A23—29 to 40 inches; yellowish brown (10YR 5/4) fine sand, very pale brown (10YR 7/3) dry; single grained; loose; medium acid; gradual smooth boundary.

A&B—40 to 60 inches; yellowish brown (10YR 5/4) fine sand (A2); single grained; loose; numerous 1/4- to 1-inch bands of dark brown (7.5YR 3/2) sandy loam (B2); weak fine subangular blocky structure; very friable; slightly acid.

The solum ranges from 4 to about 7 feet in thickness. The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 2 to 6 inches thick. It typically is loamy fine sand but in some pedons is fine sand. The Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 3/3), or brown (10YR 4/3). The A2 horizon is medium acid or strongly acid. It is dark grayish brown (10YR 4/2), brown (10YR 4/3), or dark yellowish brown (10YR 4/4) in the upper part and dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), or light yellowish brown (10YR 6/4) in the lower part. The B part of the A&B horizon occurs as sandy loam lamellae 1/4 inch to 2 inches thick. It has hue of 7.5YR or 10YR and value and chroma of 2 to 4. The depth to the uppermost lamella ranges from 27 to 48 inches.

Clyde series

The Clyde series consists of poorly drained, moderately permeable soils in upland drainageways. These soils formed in 30 to 50 inches of glacial outwash or erosional sediments and in the underlying glacial till. A band of pebbles commonly separates the glacial till from the overlying material. The native vegetation was water-tolerant grasses. Slope ranges from 1 to 4 percent.

Clyde soils are similar to Floyd soils and commonly are adjacent to Bassett, Floyd, Kenyon, Oran, and Palms soils. Floyd soils are somewhat poorly drained and are on concave side slopes above the Clyde soils. Bassett and Kenyon soils are moderately well drained and are on convex ridges and side slopes above the Clyde soils. Oran soils are on ridges above the Clyde soils. Their B horizon is browner than that of the Clyde soils. Also, their A horizon is thinner. Palms soils formed in organic material in depressions below the Clyde soils.

Typical pedon of Clyde clay loam, 1 to 3 percent slopes, in a permanent pasture; 120 feet east and 2,112 feet south of the northwest corner of sec. 31, T. 91 N., R. 6 W.

A11—0 to 9 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—9 to 17 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A3g—17 to 23 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry, very dark gray (10YR 3/1) kneaded; black (10YR 2/1) coatings on faces of peds; few fine distinct light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B2g—23 to 34 inches; mottled gray (5Y 5/1) and light olive brown (2.5Y 5/6) silty clay loam; few dark gray (5Y 4/1) coatings on faces of peds; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; neutral; clear smooth boundary.

B31g—34 to 39 inches; mottled gray (5Y 5/1) and strong brown (7.5YR 5/6) sandy loam; weak medium prismatic structure; friable; slightly acid; clear smooth boundary.

IIB32—39 to 43 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) loam; weak medium prismatic structure; firm; slightly acid; abrupt wavy boundary.

IIC—43 to 60 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) loam; massive; firm; strong effervescence; mildly alkaline.

The solum ranges from 30 to 60 inches in thickness. It is neutral or slightly acid. The depth to carbonates ranges from 40 to 60 inches. The depth of the erosional sediments or glacial outwash over the glacial till typically is about 39 inches but ranges from 30 to 50 inches.

The A horizon is 18 to 24 inches thick. It is dominantly clay loam, but the range includes silty clay loam and loam. The B horizon has hue of 5Y or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is dominantly loam, silty clay loam, or clay loam, but most pedons have thin strata of sandy loam or loamy sand, typically less than 6 inches thick.

Colo series

The Colo series consists of poorly drained, moderately permeable soils on bottom land. These soils formed in silty alluvium. The native vegetation was water-tolerant grasses. Slope ranges from 0 to 2 percent.

Colo soils are similar to Otter soils and commonly are adjacent to Huntsville and Ossian soils. The A horizon of Otter soils has a lower content of clay than that of the Colo soils. The well drained Huntsville soils are in the higher lying areas on the bottom land. Their A horizon is browner than that of the Colo soils. Ossian soils are in positions on the landscape similar to those of the Colo soils. Their A horizon is thinner than that of the Colo soils and has a lower content of clay.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, in a permanent pasture; 153 feet south and 186 feet east of the northwest corner of sec. 36, T. 94 N., R. 4 W.

A11—0 to 6 inches; very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on faces of peds; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—6 to 20 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine and very fine subangular blocky and weak fine granular structure; friable; slightly acid; gradual smooth boundary.

A13—20 to 31 inches; black (5Y 2/1) silty clay loam, very dark gray (5Y 3/1) dry; moderate fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A14—31 to 42 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; few fine faint dark grayish brown (2.5Y 4/2) mottles; weak fine subangular blocky structure; friable; few fine faint dark reddish concretions (iron oxide); neutral; clear smooth boundary.

A15—42 to 50 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few dark reddish concretions (iron oxide); neutral; gradual smooth boundary.

C—50 to 60 inches; dark gray (5Y 4/1) silty clay loam; few fine distinct olive gray (5Y 5/2) mottles; massive; friable; neutral.

The solum ranges from 36 to 54 inches in thickness. It is neutral or slightly acid. The A horizon typically is silty clay loam in which the content of clay ranges from 27 to 34 percent, but the upper 10 inches in some pedons is silt loam. Colors that have value of 3 or less extend to a depth of 36 inches or more. The C horizon has hue of 5Y or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It has few to common mottles of high chroma in some pedons.

Dorchester series

The Dorchester series consists of moderately well drained, moderately permeable soils on bottom land. These soils formed in calcareous, stratified recent alluvium. The native vegetation was deciduous trees. Slope ranges from 0 to 5 percent.

Dorchester soils commonly are adjacent to Caneek, Medary Variant, Spillville, Volney, and Zwingle soils. Caneek and Spillville soils are in the lower lying areas on the bottom land. Caneek soils have mottles and the grayer colors in the upper part and are somewhat poorly drained or poorly drained. Spillville soils have a loamy A horizon that is thicker and darker than that of the

Dorchester soils. Also, they are not stratified. Medary Variant and Zwingle soils have a clayey B horizon. They are on high stream benches above the Dorchester soils. Volney soils contain coarse limestone fragments throughout. They are in positions on the landscape similar to those of the Dorchester soils.

Typical pedon of Dorchester silt loam, 0 to 2 percent slopes, in a cultivated field; 660 feet east and 75 feet north of the southwest corner of sec. 8, T. 91 N., R. 4 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1—8 to 31 inches; stratified dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), and brown (10YR 5/3) silt loam; massive but tending to be platy because of geologic deposition; friable; common fine distinct brown (7.5YR 4/4) oxides; slight effervescence; mildly alkaline; abrupt wavy boundary.

IIA11b—31 to 49 inches; black (10YR 2/1) silt loam; weak fine granular structure; friable; neutral; gradual smooth boundary.

IIA12b—49 to 60 inches; very dark brown (10YR 2/2) silt loam; black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral.

The depth to the IIAb horizon generally is 30 to 45 inches. In some pedons, however, this horizon is 20 to 30 inches from the surface or does not occur.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 5/3). The C horizon typically is dark grayish brown (10YR 4/2) or brown (10YR 5/3) but has thin very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2) strata. It typically is silt loam but in some pedons has thin strata of loam. It is mildly alkaline or moderately alkaline. The IIAb horizon is silt loam, clay loam, or silty clay loam. It is neutral or mildly alkaline.

Downs series

The Downs series consists of well drained, moderately permeable soils on loess-covered uplands. These soils formed in loess. The native vegetation was mixed grasses and trees. Slope ranges from 2 to 18 percent.

Downs soils are similar to Fayette, Festina, and Orwood soils and commonly are adjacent to Atterberry, Fayette, Frankville, Luana, and Tama soils. The A1 horizon of Fayette soils is thinner than that of the Downs soils. Also, the A2 horizon is more distinct. Festina soils contain less clay in the B2 horizon than the Downs soils and have a stratified substratum. Luana soils are underlain by residuum of limestone at a depth of 20 to 40 inches. Orwood soils contain more sand throughout than the Downs soils. The B horizon of Atterberry soils is grayer than that of the Downs soils. Frankville soils are underlain by limestone bedrock at a depth of 20 to 30 inches. Tama soils do not have an A2 horizon. Their A1 horizon is thicker than that of the Downs soils. Atterberry soils are on broad ridges above the Downs soils. Fayette and Tama soils are in positions on the landscape similar to those of the Downs soils. Frankville and Luana soils are on convex side slopes below the Downs soils.

Typical pedon of Downs silt loam, 2 to 5 percent slopes, in a cultivated field; 1,100 feet north and 50 feet east of the southwest corner of sec. 13, T. 94 N., R. 4 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.

A2—8 to 12 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium platy structure parting to weak fine granular; friable; thin discontinuous silt coatings, gray (10YR 6/1) dry; medium acid; clear smooth boundary.

B1—12 to 17 inches; brown (10YR 4/3) silt loam; moderate fine and very fine subangular blocky structure; friable; thin discontinuous silt coatings, gray (10YR 6/1) dry; strongly acid; gradual smooth boundary.

B21t—17 to 24 inches; dark yellowish brown (10YR 4/4) silty clay loam; brown (10YR 4/3) coatings on faces of peds; moderate fine subangular blocky structure; friable; thin discontinuous dark brown (10YR 3/3) clay films; thin discontinuous silt coatings, light gray (10YR 7/1) dry; strongly acid; gradual smooth boundary.

B22t—24 to 33 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 4/3) coatings on faces of peds; weak medium subangular blocky structure; friable; thin discontinuous dark yellowish brown (10YR 3/4) clay films; thin discontinuous silt coatings, light gray (10YR 7/1) dry; strongly acid; gradual smooth boundary.

B31t—33 to 39 inches; yellowish brown (10YR 5/4) silt loam; brown (10YR 5/3) coatings on faces of peds; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; few thin discontinuous dark yellowish brown (10YR 3/4) clay films; thin discontinuous silt coatings, light gray (10YR 7/1) dry; strongly acid; gradual smooth boundary.

B32—39 to 48 inches; yellowish brown (10YR 5/4) silt loam; brown (10YR 5/3) coatings on faces of peds; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; thin discontinuous silt coatings, light gray (10YR 7/1) dry; few dark reddish concretions (iron oxide); medium acid; clear smooth boundary.

C—48 to 60 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct strong brown (7.5YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; massive; friable; few dark reddish concretions (iron oxide); medium acid.

The thickness of the solum ranges from 42 to 70 inches. The A1 horizon, if it occurs, is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. The A2 horizon is dark grayish brown (10YR 4/2) or brown (10YR 5/3). In some pedons it is wholly incorporated into the Ap horizon. The B horizon has value of 4 or 5 and chroma of 4 to 6 in the lower part. It does not have low chroma mottles to a depth of 36 inches or more. It ranges from medium acid to very strongly acid. The B2t horizon is silty clay loam in which the content of clay ranges from 27 to 34 percent.

Dubuque series

The Dubuque series consists of well drained soils that are moderately permeable in the upper part and are slowly permeable in the lower part of the subsoil. These soils are on loess-covered uplands. They formed in loess and in a thin layer of limestone residuum. The native vegetation was deciduous trees. Slope ranges from 5 to 25 percent.

Dubuque soils are similar to Frankville soils and commonly are adjacent to Fayette, Jacwin, Nordness, and Volney soils. Fayette soils are not underlain by limestone bedrock within a depth of 60 inches. They are on convex slopes above the Dubuque soils. The A horizon of Frankville soils is darker than that of the Dubuque soils. Jacwin soils formed in loamy material and the underlying clayey residuum of shale. They are on linear slopes below the Dubuque soils. Nordness soils are underlain by limestone bedrock within a depth of 20 inches. They are on convex slopes below the Dubuque soils. Volney soils formed in loamy alluvium containing limestone fragments. They are on alluvial fans below the Dubuque soils.

Typical pedon of Dubuque silt loam, 20 to 30 inches to limestone, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 2,140 feet east and 520 feet north of the center of sec. 10, T. 93 N., R. 6 W.

Ap—0 to 6 inches; mixed dark grayish brown (10YR 4/2) and brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak thin platy structure; friable; slightly acid; abrupt smooth boundary.

B1—6 to 9 inches; yellowish brown (10YR 5/4) silt loam; brown (10YR 4/3) coatings on faces of peds; weak thin platy structure parting to weak fine subangular blocky; friable; nearly continuous silt coatings, light gray (10YR 7/2) dry; slightly acid; clear smooth boundary.

B21t—9 to 13 inches; yellowish brown (10YR 5/6) silty clay loam; moderate fine angular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay films; discontinuous silt coatings, light gray (10YR 7/2) dry; slightly acid; clear smooth boundary.

B22t—13 to 21 inches; yellowish brown (10YR 5/4) silty clay loam; strong fine angular blocky structure; firm; thin discontinuous brown (10YR 4/3) clay films; medium acid; abrupt wavy boundary.

IIB23t—21 to 26 inches; mixed brown (7.5YR 4/4) and reddish brown (2.5YR 4/4) clay; strong medium angular blocky structure; very firm; thick nearly continuous dark brown (7.5YR 3/2) clay films; medium acid; abrupt wavy boundary.

IIR1—26 to 29 inches; flags of limestone interbedded with clay residuum; strong effervescence; moderately alkaline.

IIR2—29 inches; hard, fractured limestone bedrock.

The depth to limestone bedrock ranges from 20 to 30 inches. The solum ranges from slightly acid to strongly acid.

The A1 horizon, if it occurs, is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 2 to 4 inches thick. The Ap horizon is dark grayish brown (10YR 4/2) and brown (10YR 4/3 or 5/3). Some pedons have an A2 horizon. This horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 5/3). It is 4 to 8 inches thick. In many cultivated areas it is incorporated into the Ap horizon. The IIB23t horizon is silty clay or clay. It is 1 to 5 inches thick.

Exette series

The Exette series consists of well drained, moderately permeable soils on side slopes and head slopes in the uplands. These soils formed in loess. The native vegetation was deciduous trees. Slope ranges from 9 to 25 percent.

Exette soils commonly are adjacent to Fayette, Lindley, and Orion soils. Fayette soils are on convex slopes above the Exette soils. Their B horizon is browner than that of the Exette soils. Also, it has a higher content of clay. Lindley soils formed in glacial till and contain more sand throughout the solum than the Exette soils. They are on convex slopes below the Exette soils. The somewhat poorly drained Orion soils formed in silty alluvium in drainageways.

Typical pedon of Exette silt loam, 18 to 25 percent slopes, moderately eroded, in a cultivated field; 1,115

feet south and 1,600 feet west of the northeast corner of sec. 2, T. 92 N., R. 5 W.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; dark grayish brown (10YR 4/2) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

B1—6 to 12 inches; brown (10YR 4/3) silt loam; few dark grayish brown (10YR 4/2) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B21—12 to 18 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable; common dark concretions (iron and manganese oxide); neutral; clear smooth boundary.

B22—18 to 23 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B3—23 to 38 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct yellowish brown (10YR 5/8) and light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; large light brown (7.5YR 6/4) and brown (7.5YR 4/2) iron accumulations; neutral; clear smooth boundary.

C1—38 to 52 inches; light brownish gray (2.5Y 6/2) silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; massive; friable; large yellowish red (5YR 4/6) iron accumulations; dark reddish concretions (iron oxide); neutral; abrupt wavy boundary.

C2—52 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; massive; friable; few small yellowish red (5YR 4/6) iron accumulations; strong effervescence; mildly alkaline.

The solum ranges from 30 to 45 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The B2 and B3 horizons have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. Mottles are within a depth of 30 inches. They have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 8. At least 20 percent of the mottles within a depth of 30 inches have chroma of 2. The content of clay is highest near the surface. It ranges from 18 to 26 percent in the Ap and B1 horizons and from 15 to 22 percent in the B2, B3, and C horizons. The B horizon ranges from neutral to medium acid.

Fayette series

The Fayette series consists of well drained, moderately permeable soils on uplands and on stream benches. These soils formed in loess. The native vegetation was deciduous trees. Slope ranges from 2 to 40 percent.

Fayette soils are similar to Downs and Orwood soils and commonly are adjacent to Downs, Dubuque, Exette, Lindley, and Nordness soils. Downs soils are on uplands. Their A1 horizon is thicker than that of the Fayette soils, and their A2 horizon is less distinct. Dubuque, Exette, Lindley, and Nordness soils are on side slopes below the Fayette soils. Dubuque soils are underlain by limestone bedrock at a depth of 20 to 30 inches. Exette soils contain less clay in the B2 horizon than the Fayette soils. Lindley soils formed in glacial till and contain more sand than the Fayette soils. Nordness soils are underlain by limestone bedrock within a depth of 20 inches. Orwood soils contain more sand throughout than the Fayette soils. Also, they have a darker A horizon.

Typical pedon of Fayette silt loam, 5 to 9 percent slopes, 75 feet inside the entrance to Pikes Peak State Park and 25 feet to the right; 1,395 feet east and 760 feet north of the southwest corner of sec. 35, T. 95 N., R. 3 W.

A1—0 to 2 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate very fine granular structure; friable; medium acid; abrupt smooth boundary.

A2—2 to 9 inches; grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; moderate thin platy structure; friable; very strongly acid; clear smooth boundary.

B1—9 to 17 inches; brown (10YR 4/3) silt loam; moderate very fine subangular blocky structure; friable; thin nearly continuous silt coatings on faces of peds, light gray (10YR 7/2) dry; very strongly acid; clear smooth boundary.

B21t—17 to 25 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine subangular and angular blocky structure; friable; thin nearly continuous strong brown (7.5YR 5/6) clay films; few thin discontinuous silt coatings, light gray (10YR 7/2) dry; very strongly acid; clear smooth boundary.

B22t—25 to 36 inches; yellowish brown (10YR 5/4) silty clay loam; strong medium angular blocky structure; friable; thin nearly continuous dark yellowish brown (10YR 4/4) clay films; few dark concretions (manganese oxide); very strongly acid; clear smooth boundary.

B23t—36 to 43 inches; yellowish brown (10YR 5/4) silty clay loam; strong medium angular blocky structure; friable; thin nearly continuous dark yellowish brown (10YR 4/4) clay films; very strongly acid; clear smooth boundary.

B3t—43 to 48 inches; yellowish brown (10YR 5/6) silt loam; moderate medium prismatic structure parting to moderate fine subangular blocky; friable; thin discontinuous dark yellowish brown (10YR 4/4) clay films; strongly acid; clear smooth boundary.

C—48 to 60 inches; yellowish brown (10YR 5/6) silt loam; few fine distinct strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; massive; few dark concretions (iron and manganese oxide); strongly acid.

The thickness of the solum ranges from 40 to 60 inches. The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 2 to 4 inches thick. The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The A2 horizon, if it occurs, is 4 to 8 inches thick. In some cultivated areas it is incorporated into the Ap horizon. The B2 horizon is silty clay loam in which the content of clay ranges from 30 to 35 percent. It is strongly acid or very strongly acid. The B horizon has no mottles of low chroma to a depth of 30 inches or more.

Festina series

The Festina series consists of well drained soils on stream benches. Permeability of these soils is moderate in the upper part and moderately rapid in the substratum. They formed in silty alluvium underlain by stratified alluvium. The native vegetation was mixed grasses and trees. Slope ranges from 0 to 2 percent.

Festina soils are similar to Bertrand and Downs soils and commonly are adjacent to Bertrand, Canoe, and Richwood soils. Bertrand and Richwood soils are in positions on the landscape similar to those of the Festina soils. The A1 horizon of Bertrand soils is thinner than that of the Festina soils, and the A2 horizon is more distinct. The A horizon of Richwood soils is thicker than that of the Festina soils. The somewhat poorly drained Canoe soils are in the lower lying areas on the stream benches. They are grayer in the upper part of the B horizon than the Festina soils. Downs soils have a higher content of clay in the B2 horizon than the Festina soils and are not stratified in the C horizon.

Typical pedon of Festina silt loam, 0 to 2 percent slopes, in a cultivated field; 1,210 feet north and 430 feet west of the southeast corner of sec. 19, T. 94 N., R. 6 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few very dark brown (10YR 2/2) coatings on faces of peds; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A2—8 to 13 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak thin platy structure parting to weak fine subangular blocky; friable; slightly acid; clear smooth boundary.

B1—13 to 17 inches; yellowish brown (10YR 5/4) silt loam; brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; friable; thin discontinuous silt coatings, white (10YR 8/1) dry; slightly acid; clear smooth boundary.

B21—17 to 24 inches; yellowish brown (10YR 5/4) silt loam; weak medium and fine subangular blocky structure; friable; thin discontinuous silt coatings, white (10YR 8/1) dry; medium acid; clear smooth boundary.

B22t—24 to 37 inches; yellowish brown (10YR 5/4) silt loam; moderate medium subangular blocky structure; friable; nearly continuous silt coatings, white (10YR 8/1) dry; thin nearly continuous very dark grayish brown (10YR 3/2) clay films; strongly acid; clear smooth boundary.

B3t—37 to 43 inches; yellowish brown (10YR 5/4) silt loam; weak medium prismatic structure; friable; thin discontinuous very dark grayish brown (10YR 3/2) clay films; strongly acid; clear smooth boundary.

C—43 to 60 inches; yellowish brown (10YR 5/4) silt loam that has common lenses of brown (7.5YR 4/4) loamy sand; massive; friable; strongly acid.

The thickness of the solum typically is about 43 inches but ranges from 36 to 60 inches. The A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It is 6 to 9 inches thick. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The A2 horizon generally is 4 to 10 inches thick, but in some pedons it is thinner because part of it has been incorporated into the Ap horizon. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam. Some lenses or strata of sandy material are below a depth of 40 inches in most pedons.

Flagler series

The Flagler series consists of somewhat excessively drained soils. Permeability of these soils is moderately rapid in the upper part and very rapid in the substratum. These soils are on stream benches. They formed in moderately coarse textured alluvium over sand and gravel. The native vegetation was grasses. Slope ranges from 0 to 5 percent.

Flagler soils are similar to Saude soils and commonly are adjacent to Lawler and Saude soils. The adjacent soils contain less sand in the A horizon and the upper part of the B horizon than the Flagler soils. The somewhat poorly drained Lawler soils are in the lower lying areas on the stream benches. The well drained Saude soils are in positions on the stream benches similar to those of the Flagler soils.

Typical pedon of Flagler sandy loam, 0 to 2 percent slopes, in a cultivated field; 1,400 feet south and 420 feet east of the center of sec. 32, T. 93 N., R. 2 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure; very friable; medium acid; abrupt smooth boundary.

A12—10 to 19 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; very friable; about 2 to 5 percent gravel; strongly acid; clear smooth boundary.

B1—19 to 26 inches; brown (10YR 4/3) sandy loam; few very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium subangular blocky structure; very friable; about 2 to 5 percent gravel; strongly acid; clear smooth boundary.

B2—26 to 33 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; about 5 to 10 percent gravel; strongly acid; clear smooth boundary.

IIC—33 to 60 inches; yellowish brown (10YR 5/6) gravelly sand; single grained; loose; medium acid.

The solum ranges from 24 to 40 inches in thickness. It is medium acid or strongly acid. The depth to loamy sand, gravelly sand, or sand ranges from 24 to 36 inches.

The A1 or Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The A horizon is about 12 to 22 inches thick. The B2 horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. The content of clay in this horizon ranges from 10 to 15 percent and the content of sand generally from 60 to 70 percent. The IIC horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. It is gravelly sand, gravelly loamy sand, or coarse sand. The content of gravel is, by volume, about 20 to 25 percent.

Floyd series

The Floyd series consists of somewhat poorly drained, moderately permeable soils on glacial till uplands adjacent to drainageways. These soils formed in loamy, stratified material and in the underlying glacial till. The native vegetation was grasses. Slope ranges from 1 to 4 percent.

Floyd soils are similar to Clyde and Lawler soils and commonly are adjacent to Bassett, Clyde, Kenyon, and Oran soils. The poorly drained Clyde soils are in the drainageways below the Floyd soils. Lawler soils are underlain by sand and gravel. The moderately well drained Bassett and Kenyon soils are on convex ridges and side slopes above the Floyd soils. Oran soils are on broad ridges above the Floyd soils. Their A horizon is lighter colored than that of the Floyd soils.

Typical pedon of Floyd loam, in a cultivated area of Clyde-Floyd complex, 1 to 4 percent slopes; 1,770 feet east and 780 feet north of the southwest corner of sec. 31, T. 91 N., R. 6 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 15 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

B1—15 to 19 inches; dark grayish brown (2.5Y 4/2) loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21—19 to 25 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B22—25 to 33 inches; mottled grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) sandy loam; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

B31—33 to 36 inches; mottled grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) loamy sand; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

IIB32—36 to 49 inches; strong brown (7.5YR 5/6) loam; common medium prominent grayish brown (2.5YR 5/2) mottles; weak medium prismatic structure; firm; neutral; abrupt wavy boundary.

IIC—49 to 60 inches; mottled strong brown (7.5YR 5/6) and grayish brown (2.5Y 5/2) loam; massive; firm; strong effervescence; mildly alkaline.

The solum ranges from about 40 to 60 inches in thickness. It is neutral or slightly acid. The depth to glacial till ranges from 30 to 45 inches. The depth to carbonates ranges from 45 to 70 inches.

The A horizon typically is loam, but the range includes clay loam, silty clay loam, and silt loam. The Ap or A1 horizon is black (10YR 2/1) or very dark gray (10YR 3/1). Some pedons have an A3 horizon, which is very dark gray (10YR 3/1) or very dark grayish brown (2.5Y 3/2). The B2 horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 or 5, and chroma of 2 to 6. The B horizon is dominantly loam, clay loam, or sandy clay loam, but most pedons have thin strata of sandy loam or loamy sand, which generally are less than 6 inches thick.

Frankville series

The Frankville series consists of well drained, moderately permeable soils on uplands. These soils formed in 20 to 30 inches of loess and in a thin layer of limestone residuum. The native vegetation was mixed grasses and trees. Slope ranges from 5 to 18 percent.

Frankville soils are similar to Dubuque and Luana soils and commonly are adjacent to Downs and Mottland soils. The A horizon of Dubuque soils is thinner and

lighter colored than that of the Frankville soils. Luana and Mottland soils formed in residuum of limestone. They are on side slopes above the Frankville soils. Downs soils formed in loess more than 60 inches thick. They are on convex ridges and side slopes above the Frankville soils.

Typical pedon of Frankville silt loam, 20 to 30 inches to limestone, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 900 feet south and 625 feet west of the center of sec. 3, T. 94 N., R. 4 W.

Ap—0 to 8 inches; mixed very dark grayish brown (10YR 3/2) and brown (10YR 4/3) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

B1—8 to 12 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21t—12 to 21 inches; yellowish brown (10YR 5/6) silty clay loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; moderate fine subangular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay films; slightly acid; clear smooth boundary.

B22t—21 to 26 inches; yellowish brown (10YR 5/6) silty clay loam; moderate fine subangular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay films; medium acid; clear smooth boundary.

IIB23t—26 to 28 inches; brown (7.5YR 4/4) silty clay; moderate medium and fine subangular blocky structure; very firm; thick discontinuous brown (7.5YR 4/4) clay films; slightly acid; abrupt wavy boundary.

IIR—28 inches; hard, fractured limestone bedrock.

The thickness of the solum, or the depth to limestone bedrock, ranges from 20 to 30 inches. The A1 horizon is very dark gray (10YR 3/1) or very dark brown (10YR 2/2). It is 6 to 9 inches thick. The Ap horizon is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1). In most cultivated areas it is mixed with some brown (10YR 4/3) material from the upper part of the B horizon. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 5 or 6. The IIB23t horizon is clay or silty clay and is 1 to 5 inches thick. It has hue of 10YR or 7.5YR and value and chroma of 4 to 6.

Goss series

The Goss series consists of well drained and somewhat excessively drained soils. Permeability of these soils is moderately rapid in the upper part and moderate in the subsoil. These soils are on upland ridges and side slopes. They formed in 8 to 18 inches of loamy material and in the underlying cherty limestone residuum (fig. 18). The native vegetation was deciduous trees. Slope ranges from 9 to 18 percent.

Figure 18.—Profile of Goss loam, which formed partly in residuum of cherty limestone.

Goss soils commonly are adjacent to Chelsea and Winneshiek soils. Chelsea soils formed in eolian fine

sand. They are on convex slopes above the Goss soils. Winneshiek soils are underlain by hard, fractured limestone bedrock. They formed in loamy material and in a layer of limestone residuum less than 6 inches thick. They are in positions on the landscape similar to those of the Goss soils.

Typical pedon of Goss loam, 9 to 18 percent slopes, in a permanent pasture; 1,250 feet south and 40 feet east of the center of sec. 27, T. 91 N., R. 6 W.

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; about 10 percent chert fragments 5 to 60 millimeters in diameter; slightly acid; clear smooth boundary.

A21—3 to 9 inches; dark grayish brown (10YR 4/2) cherty fine sandy loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; about 15 to 20 percent chert fragments 5 to 60 millimeters in diameter; medium acid; clear smooth boundary.

A22—9 to 12 inches; reddish brown (5YR 4/3) and dark brown (7.5YR 4/4) cherty fine sandy loam, brown (7.5YR 5/4) dry; weak fine subangular blocky structure; very friable; about 20 to 30 percent chert fragments 5 to 60 millimeters in diameter; medium acid; abrupt wavy boundary.

IIB21t—12 to 24 inches; dark red (10R 3/6) very cherty clay; strong fine angular and subangular blocky structure; firm; about 60 to 70 percent chert fragments 5 to 60 millimeters in diameter; strongly acid; thick nearly continuous dusky red (10R 3/3) clay films; clear smooth boundary.

IIB22t—24 to 37 inches; dark red (10R 3/6) and red (10R 4/8) very cherty clay; strong fine angular and subangular blocky structure; firm; about 70 to 80 percent chert fragments 5 to 60 millimeters in diameter; very strongly acid; thick nearly continuous dusky red (10R 3/4) clay films; clear smooth boundary.

IIB23t—37 to 49 inches; red (10R 4/6) very cherty clay; dark red (10R 3/6) coatings on faces of peds; strong fine angular and subangular blocky structure; firm; about 65 to 75 percent chert fragments 5 to 60 millimeters in diameter; very strongly acid; thick nearly continuous dusky red (10R 3/4) clay films; clear smooth boundary.

IIB24t—49 to 60 inches; red (10R 4/6) very cherty clay; dark red (10R 3/6) coatings on faces of peds; strong fine angular and subangular blocky structure; firm; about 70 to 80 percent chert fragments 5 to 60 millimeters in diameter; very strongly acid; thick nearly continuous dusky red (10R 3/4) clay films.

The thickness of the solum ranges from 60 to 80 inches. The depth to residuum of cherty limestone ranges from 8 to 18 inches. The content of chert fragments ranges from 10 to 30 percent in the A horizon and from 45 to 80 percent in the IIB2t horizon.

The A horizon typically is loam, but the range includes silt loam and sandy loam. The IIB2t horizon has hue of 10R to 7.5YR, value of 3 to 5, and chroma of 4 to 8. It is cherty or very cherty clay or silty clay. It ranges from medium acid to very strongly acid.

Huntsville series

The Huntsville series consists of well drained, moderately permeable soils on narrow bottom land. These soils formed in silty alluvium. The native vegetation was grasses. Slope ranges from 0 to 2 percent.

Huntsville soils are similar to Kennebec and Worthen soils and commonly are adjacent to Arenzville, Chaseburg, Colo, Kennebec, and Otter soils. Kennebec soils are somewhat poorly drained. The upper part of their B horizon is grayer than that of the Huntsville soils. The B horizon of Worthen soils is more strongly expressed and more acid than that of the Huntsville soils. Arenzville soils formed in stratified sediments 20 to 40 inches deep over an older buried soil. Chaseburg soils formed in stratified sediments. Colo and Otter soils are poorly drained. They do not have a B horizon, and their C horizon is grayer than that of the Huntsville soils. Arenzville and Chaseburg soils are in positions on bottom land similar to those of the Huntsville soils. Colo, Kennebec, and Otter soils are in the lower lying areas on bottom land. Worthen soils are on foot slopes.

Typical pedon of Huntsville silt loam, 0 to 2 percent slopes, 1,380 feet east and 680 feet south of the northwest corner of sec. 18, T. 92 N., R. 4 W.

A11—0 to 16 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; black (10YR 2/1) coatings on faces of peds; weak very fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

A12—16 to 22 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

A13—22 to 29 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

B2—29 to 39 inches; brown (10YR 4/3) silt loam; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

C1—39 to 54 inches; yellowish brown (10YR 5/4) silt loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; massive; friable; slightly acid; gradual smooth boundary.

C2—54 to 60 inches; yellowish brown (10YR 5/4) silt loam; few fine faint brown (10YR 5/3) and strong brown (7.5YR 5/6) mottles; massive; friable; increase in content of fine sand; neutral.

The thickness of the solum ranges from 36 to 60 inches. The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2) in the upper part and very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) in the lower part. It is 24 to 36 inches thick. The B2 horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/6). It is neutral or slightly acid. It typically is weakly expressed. Some pedons have a B3 horizon. The B3 and C horizons have few or no mottles. The C horizon is silt loam, sandy loam, or loam.

Jacwin series

The Jacwin series consists of somewhat poorly drained soils that are moderately permeable in the upper part and very slowly permeable in the lower part. These soils are on foot slopes or benches below areas where limestone crops out. They formed in 20 to 30 inches of loamy material and in the underlying residuum of shale. The native vegetation was grasses. Slope ranges from 2 to 14 percent.

Jacwin soils commonly are adjacent to Calamine, Dubuque, and Marlean soils. The poorly drained and very poorly drained Calamine soils are in the lower lying areas. The upper part of their B horizon is grayer than that of the Jacwin soils. Dubuque soils are on convex side slopes above the Jacwin soils. They are underlain by limestone bedrock. Marlean soils formed in loamy material over limestone residuum. They are on convex side slopes below the Jacwin soils.

Typical pedon of Jacwin loam, 2 to 5 percent slopes, in a permanent pasture; 810 feet west and 1,090 feet north of the southeast corner of sec. 25, T. 92 N., R. 6 W.

A1—0 to 13 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

A3—13 to 18 inches; very dark grayish brown (2.5Y 3/2) loam, grayish brown (2.5Y 5/2) dry; common fine distinct dark grayish brown (2.5Y 4/2) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B2—18 to 24 inches; dark grayish brown (2.5Y 4/2) loam; few dark gray (10YR 4/1) coatings on faces of peds; common fine distinct yellowish brown (10YR 5/6) and few fine distinct light olive brown (2.5Y 5/4 and 5/6) mottles; weak fine subangular blocky structure; friable; neutral; abrupt wavy boundary.

IIB3g—24 to 35 inches; greenish gray (5G 6/1) and yellowish brown (10YR 5/6) silty clay; weak fine angular blocky structure; extremely firm; neutral; abrupt wavy boundary.

IICr—35 to 60 inches; greenish gray (5G 6/1) and yellowish brown (10YR 5/6) silty clay shale; massive; extremely firm; many large calcium carbonate concretions; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 55 inches. The depth to shale bedrock ranges from 20 to 40 inches. The depth to carbonates commonly is 24 to 42 inches.

The A horizon typically is loam but in some pedons is silt loam or clay loam. It is 15 to 24 inches thick. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. In some pedons a thin stratum of sandy loam or loamy sand as much as 6 inches thick is between the loamy material and the clayey shale. In some pedons a small amount of fractured limestone is interbedded with the shale.

Kennebec series

The Kennebec series consists of somewhat poorly drained, moderately permeable soils on narrow bottom land. These soils formed in silty alluvium. The native vegetation was grasses. Slope ranges from 0 to 2 percent.

These soils are taxadjuncts to the Kennebec series because their A horizon is less than 36 inches thick. This difference, however, does not significantly affect the use or behavior of the soils.

Kennebec soils are similar to Huntsville and Worthen soils and commonly are adjacent to Huntsville, Ossian, and Otter soils. Huntsville and Worthen soils are well drained. The upper part of their B horizon is browner than that of the Kennebec soils. Huntsville soils are in the higher lying areas on bottom land. The poorly drained Ossian and Otter soils are in the lower lying areas on stream benches. They are grayer in the upper part of the B horizon and in the C horizon than the Kennebec soils.

Typical pedon of Kennebec silt loam, 0 to 2 percent slopes, in a cultivated field; 800 feet east and 1,235 feet north of the southwest corner of sec. 25, T. 94 N., R. 5 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 18 inches; very dark brown (10YR 2/2) silt loam, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.
A13—18 to 28 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.
A14—28 to 31 inches; very dark grayish brown (10YR 3/2) silt loam, dark gray (10YR 4/1) dry; discontinuous very dark gray (10YR 3/1) coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.
B2—31 to 41 inches; dark grayish brown (2.5Y 4/2) silt loam; few very dark grayish brown (2.5Y 3/2) coatings on faces of peds; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.
B3—41 to 50 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct light olive brown (2.5Y 5/4) and brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
C—50 to 60 inches; mixed light olive brown (2.5Y 5/4) and grayish brown (2.5Y 5/2) silt loam; few fine distinct brown (7.5YR 4/4) mottles; massive; friable; neutral.

The solum ranges from 40 to 60 inches in thickness. It is neutral or slightly acid. In some pedons thin strata of loamy sand or fine sand are below a depth of 48 inches.

The A horizon typically is silt loam but ranges to silty clay loam. It is 24 to 36 inches thick. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. It is silt loam or silty clay loam in which the content of clay ranges from 18 to 30 percent.

Kenyon series

The Kenyon series consists of moderately well drained, moderately permeable soils on upland ridges and side slopes. These soils formed in loamy sediments and in the underlying glacial till. The native vegetation was grasses. Slope ranges from 2 to 5 percent.

Kenyon soils are similar to Olin soils and commonly are adjacent to Clyde, Floyd, Lilah, Olin, and Rockton soils. Olin and Lilah soils contain more sand in the A horizon and the upper part of the B horizon than the Kenyon soils. They are in positions on the landscape similar to those of the Kenyon soils. The poorly drained Clyde and somewhat poorly drained Floyd soils are on concave slopes below the Kenyon soils. The upper part of their B horizon is grayer than that of the Kenyon soils. Rockton soils are underlain by limestone bedrock. They are on convex side slopes below the Kenyon soils.

Typical pedon of Kenyon loam, 2 to 5 percent slopes, in a cultivated field; 246 feet east and 171 feet south of the northwest corner of sec. 6, T. 91 N., R. 6 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on faces of peds; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.
A12—7 to 11 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; few black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
B1—11 to 20 inches; brown (10YR 4/3) loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.
IIB21—20 to 28 inches; yellowish brown (10YR 5/4) loam; brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; friable; stone line at about 20 inches; medium acid; clear smooth boundary.
IIB22—28 to 35 inches; yellowish brown (10YR 5/6) loam; few dark yellowish brown (10YR 4/4) coatings on faces of peds; few fine distinct brown (10YR 5/3) mottles; moderate medium and fine subangular blocky structure; friable; medium acid; few pebbles; clear smooth boundary.
IIB23—35 to 45 inches; mixed grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) loam; brown (10YR 5/3) coatings on faces of peds; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; slightly acid; few pebbles; clear smooth boundary.
IIB3—45 to 50 inches; mixed yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; firm; roots extending to about 48 inches; few dark concretions (manganese oxide); slightly acid; few pebbles; clear smooth boundary.
IIC—50 to 60 inches; mixed yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) loam; common fine distinct strong brown (7.5YR 5/6) mottles; massive; firm; few gray (10YR 6/1) streaks or threads; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates range from 45 to 60 inches. The loamy sediments are 14 to 21 inches deep over the glacial till.

The Ap horizon generally is black (10YR 2/1) or very dark brown (10YR 2/2). The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). It typically is loam but in some pedons is silt loam. It is 10 to 16 inches thick. The IIB horizon is loam, clay loam, or sandy clay loam. It has hue of 10YR, value of 4 or 5,

and chroma of 2 to 6. The coatings on the faces of peds in this horizon generally have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3.

Lamont series

The Lamont series consists of well drained soils that are moderately rapidly permeable in the upper part and rapidly permeable in the lower part. These soils are on upland ridges and side slopes and on high stream benches. They formed in moderately coarse and coarse textured sediments that were deposited or reworked by wind and are free of coarse sand and gravel. The native vegetation was deciduous trees. Slope ranges from 0 to 9 percent.

Lamont soils are similar to Backbone soils and commonly are adjacent to Backbone, Chelsea, and Orwood soils. They are in positions on the landscape similar to those of the adjacent soils. Backbone soils are underlain by limestone bedrock at a depth of 20 to 40 inches. The A horizon of Chelsea soils contains more sand than that of the Lamont soils. The solum of Orwood soils contains less sand throughout than that of the Lamont soils.

Typical pedon of Lamont fine sandy loam, 0 to 2 percent slopes, 720 feet west and 370 feet south of the center of sec. 20, T. 93 N., R. 2 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) fine sandy loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; medium acid; abrupt smooth boundary.

A2—7 to 15 inches; grayish brown (10YR 5/2) loamy fine sand, light yellowish brown (10YR 6/4) dry; weak thin platy structure parting to weak fine subangular blocky; very friable; common dark reddish concretions (iron oxide); strongly acid; clear smooth boundary.

B1t—15 to 19 inches; brown (7.5YR 4/4) very fine sandy loam; weak fine subangular blocky structure; very friable; few dark brown (7.5YR 3/2) clay films; strongly acid; clear smooth boundary.

B21t—19 to 31 inches; brown (7.5YR 4/6) sandy loam; dark brown (7.5YR 3/4) coatings on faces of peds; weak fine subangular blocky structure; friable; few dark reddish brown (5YR 3/2) clay films; strongly acid; clear smooth boundary.

B22t—31 to 43 inches; brown (7.5YR 4/4) sandy loam; weak fine subangular blocky structure; friable; few dark brown (7.5YR 3/2) clay films; strongly acid; clear smooth boundary.

B3t—43 to 60 inches; brown (7.5YR 4/4) loamy fine sand; weak fine subangular blocky structure; very friable; brown (7.5YR 4/4) sandy loam bands at 44 to 50 inches; strongly acid.

The thickness of the solum ranges from 30 to 60 inches or more. The A1 or Ap horizon generally is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1) but is very dark gray (10YR 3/1) if it is less than 5 inches thick. In uneroded areas the A2 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 5/3). In some cultivated areas it is incorporated into the Ap horizon. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is medium acid or strongly acid. The B2t horizon is sandy loam, loam, or sandy clay loam.

The C horizon typically is yellowish brown (10YR 5/6) or strong brown (7.5YR 5/6), but it is interspersed with lamellae, 1/2 inch to 2 inches thick, that have hue of 7.5YR or 10YR and value and chroma of 3 or 4. The depth to the uppermost lamella ranges from 2-1/2 to 5 feet.

Lawler series

The Lawler series consists of somewhat poorly drained soils that are moderately permeable in the upper part and very rapidly permeable in the substratum. These soils are on stream benches. They formed in loamy material 24 to 40 inches deep over sand and gravel. The native vegetation was grasses. Slope ranges from 0 to 2 percent.

Lawler soils are similar to Floyd soils and commonly are adjacent to Flagler, Saude, Wapsie, and Waukee soils. Floyd soils are underlain by loamy glacial till or glacial sediments. The somewhat excessively drained Flagler and well drained Saude, Wapsie, and Waukee soils are in the higher lying areas on the stream benches. Their B horizon is browner than that of the Lawler soils. Also, the A horizon of Wapsie soils is thinner.

Typical pedon of Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field; 1,610 feet west and 615 feet north of the southeast corner of sec. 14, T. 93 N., R. 5 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; nearly continuous black (10YR 2/1) coatings on faces of peds; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—8 to 14 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; nearly continuous very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; slightly acid; clear smooth boundary.

A3—14 to 20 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) and brown (10YR 5/3) dry; discontinuous very dark gray (10YR 3/1) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21—20 to 26 inches; dark grayish brown (10YR 4/2) loam; few fine distinct dark brown (7.5YR 3/2) and brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B22—26 to 33 inches; dark grayish brown (10YR 4/2) loam; few fine distinct strong brown (7.5YR 5/6), brown (7.5YR 4/4), and dark brown (7.5YR 3/2) mottles; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B3—33 to 38 inches; brown (7.5YR 4/4 and 10YR 5/3) sandy loam; few fine distinct dark brown (10YR 3/3) mottles; weak fine subangular blocky structure; friable; few dark concretions (manganese oxide); slightly acid; clear smooth boundary.

IIC—38 to 60 inches; brown (7.5YR 5/4) loamy sand; about 5 percent gravel by volume; few fine distinct brown (10YR 5/3) mottles; single grained; loose; slightly acid.

The solum ranges from 24 to 40 inches in thickness. The A horizon typically is loam but in some pedons is silt loam high in content of sand. It is 12 to 22 inches thick. The A1 horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The A3 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The B2 horizon is dark grayish brown (2.5Y 4/2 or 10YR 4/2) or grayish brown (10YR 5/2 or 2.5Y 5/2) and has mottles of high chroma. It is loam or sandy clay loam. The B3 and IIC horizons are dominantly loamy sand or gravelly loamy sand but have thin layers of sandy loam in many pedons.

Lilah series

The Lilah series consists of excessively drained soils that are rapidly permeable in the upper part and very rapidly permeable in the lower part. These soils are on stream benches and in outwash areas on uplands. They formed in 10 to 20 inches of moderately coarse textured sediments and in the underlying coarse textured material. The native vegetation was grasses and trees. Slope ranges from 2 to 9 percent.

These soils are taxadjuncts to the Lilah series because the B horizon lacks a sufficient increase in clay content to qualify as an argillic horizon. This difference, however, does not significantly affect the use or behavior of the soils.

Lilah soils commonly are adjacent to Bassett, Kenyon, and Olin soils. The adjacent soils are finer textured than the Lilah soils. They formed in loamy sediments and in the underlying glacial till. They are in convex areas on uplands.

Typical pedon of Lilah sandy loam, 5 to 9 percent slopes, in a cultivated field; 1,400 feet west and 297 feet south of the northeast corner of sec. 25, T. 91 N., R. 6 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A2—8 to 11 inches; brown (10YR 4/3) sandy loam, brown (10YR 5/3) dry; dark grayish brown (10YR 4/2) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B1—11 to 17 inches; brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; about 5 percent fine gravel; slightly acid; clear smooth boundary.

B2t—17 to 26 inches; strong brown (7.5YR 5/6) loamy sand; weak fine subangular blocky structure; very friable; nearly continuous brown (7.5YR 4/4) clay bridging between sand grains; about 5 to 8 percent fine gravel; medium acid; clear smooth boundary.

B3t—26 to 40 inches; strong brown (7.5YR 5/8) loamy sand; weak fine subangular blocky structure; very friable; nearly continuous brown (7.5YR 4/4) clay bridging between sand grains; about 10 to 15 percent fine gravel; strongly acid; clear smooth boundary.

C—40 to 60 inches; strong brown (7.5YR 5/6) loamy sand; single grained; loose; about 2 percent gravel; strongly acid.

The thickness of the solum ranges from 30 to 42 inches. The depth to the coarse textured material ranges from 10 to 20 inches. The content of fine gravel in the solum ranges, by volume, from about 2 to 20 percent. The greatest concentration of gravel is within a depth of 50 inches.

The Ap horizon is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1). It typically is sandy loam but in some pedons is gravelly sandy loam. The A2 horizon is 0 to 6 inches thick. It is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The B2t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It typically is loamy sand but in some pedons is gravelly loamy sand. The C horizon ranges from strong brown (7.5YR 5/6 or 5/8) to yellowish brown (10YR 5/4 to 5/8). It is loamy sand or sand and contains some gravel.

Lindley series

The Lindley series consists of moderately well drained, moderately slowly permeable soils on upland side slopes and nose slopes. These soils formed in glacial till. The native vegetation was deciduous trees. Slope ranges from 9 to 25 percent.

Lindley soils commonly are adjacent to Chelsea, Exette, and Fayette soils on the higher lying convex slopes. The solum of Chelsea soils contains more sand throughout than that of the Lindley soils. Exette and

Fayette soils formed in loess. Their solum contains less sand throughout than that of the Lindley soils.

Typical pedon of Lindley loam, 14 to 25 percent slopes, moderately eroded, in a cultivated field; 1,025 feet west and 900 feet south of the northeast corner of sec. 2, T. 92 N., R. 5 W.

Ap—0 to 6 inches; mixed dark grayish brown (10YR 4/2) and brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

B1—6 to 13 inches; yellowish brown (10YR 5/4) loam; brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B21t—13 to 19 inches; yellowish brown (10YR 5/6 and 5/4) clay loam; brown (10YR 4/3) coatings on faces of peds; moderate medium subangular blocky structure; friable; thin discontinuous brown (7.5YR 4/2) clay films; medium acid; gradual smooth boundary.

B22t—19 to 27 inches; yellowish brown (10YR 5/4) clay loam; brown (10YR 4/3) coatings on faces of peds; moderate medium subangular blocky structure; friable; thin discontinuous brown (7.5YR 4/2) clay films; strongly acid; clear smooth boundary.

B3—27 to 37 inches; yellowish brown (10YR 5/4) clay loam; brown (10YR 5/3) coatings on faces of peds; few fine distinct gray (5Y 5/1) and common fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; firm; many dark concretions (manganese oxide); strongly acid; clear smooth boundary.

C—37 to 60 inches; strong brown (7.5YR 5/6) clay loam; common medium distinct gray (5Y 5/1) mottles; massive; firm; many dark concretions (manganese oxide); neutral.

The thickness of the solum ranges from 30 to 50 inches. The Ap horizon typically is loam but in some pedons is silt loam or clay loam. The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. The lower part of the B2t horizon and the B3 horizon are mottled in some pedons. The content of clay in the B2t and B3 horizons ranges from 28 to 32 percent. The C horizon is yellowish brown (10YR 5/6) or strong brown (7.5YR 5/6) and is commonly mottled with gray (5Y 5/1) or grayish brown (2.5Y 5/2).

Luana series

The Luana series consists of well drained soils. Permeability is moderate in the upper part and moderately rapid in the substratum. These soils are on upland ridges and side slopes. They formed in 20 to 40 inches of loess and in the underlying residuum of limestone. The native vegetation was mixed grasses and trees. Slope ranges from 5 to 14 percent.

Luana soils are similar to Frankville soils and commonly are adjacent to Downs and Mottland soils. Downs soils formed in a layer of loess more than 60 inches thick. They are on ridges and side slopes above the Luana soils. Frankville soils are underlain by hard limestone bedrock. Mottland soils are underlain by material weathered from limestone within a depth of 20 inches. They commonly are on side slopes below the Luana soils.

Typical pedon of Luana silt loam, 5 to 9 percent slopes, in a cultivated field; 1,980 feet east and 80 feet north of the center of sec. 3, T. 95 N., R. 5 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A2—6 to 9 inches; dark grayish brown (10YR 4/2) silt loam, brown (10YR 5/3) dry; few dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2) coatings on faces of peds; weak thin platy structure parting to weak fine subangular blocky; friable; slightly acid; clear smooth boundary.

B1—9 to 13 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21t—13 to 23 inches; yellowish brown (10YR 5/4) silt loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak fine subangular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay flows; slightly acid; abrupt smooth boundary.

IIB22t—23 to 27 inches; brownish yellow (10YR 6/6) silty clay; moderate fine subangular blocky and strong fine angular blocky structure; firm; thin discontinuous brown (10YR 4/3) clay films; slightly acid; abrupt wavy boundary.

IIC—27 to 60 inches; yellow (10YR 7/6) flaggy sandy loam; estimated 20 to 30 percent hard fragments; massive; friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The Ap or A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. The A2 horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 5/3). In some cultivated areas it is incorporated into the Ap horizon. The IIB horizon is silty clay loam or silty clay. It is 1 to 5 inches thick. Some pedons do not have this horizon. The IIC horizon is flaggy sandy loam or flaggy silt loam. It has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 4 to 8. The content of hard limestone fragments in this horizon ranges from 10 to 40 percent.

Marlean series

The Marlean series consists of well drained soils. Permeability is moderate in the upper part and moderately rapid in the substratum. These soils are on upland ridges and side slopes. They formed in loamy material over limestone residuum. The native vegetation was grasses. Slope ranges from 2 to 14 percent.

Marlean soils are similar to Volney soils and commonly are adjacent to Backbone, Calamine, Jacwin, and Sparta soils. The A horizon of Volney soils is thicker than that of the Marlean soils. Backbone and Sparta soils are on convex slopes above the Marlean soils. Backbone soils contain more sand in the A and B horizons than the Marlean soils and have hard limestone bedrock at a depth of 20 to 40 inches. Sparta soils formed in more than 40 inches of loamy sand or sand. The poorly drained and very poorly drained Calamine and somewhat poorly drained Jacwin soils are on linear slopes above the Marlean soils. They are underlain by clayey shale.

Typical pedon of Marlean loam, 2 to 5 percent slopes, in a cultivated field; 660 feet west and 1,180 feet north of the center of sec. 2, T. 92 N., R. 6 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

B2—8 to 12 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

IIC—12 to 60 inches; mixed very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), and brown (10YR 4/3) very channery loam; massive; friable; about 40 percent fragments 1 to 6 inches long and about 20 percent fragments 6 to 9 inches long; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 4 to 18 inches. The A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The A horizon typically is loam but in some pedons is silt loam. It is 5 to 15 inches thick. The B2 horizon has value of 3 or 4 and chroma of 2 to 4. It is loam or clay loam. The IIC horizon is channery or very channery loam in which the content of limestone and chert fragments ranges from 40 to 70 percent.

Medary Variant

The Medary Variant consists of moderately well drained soils that are very slowly permeable in the subsoil and moderately rapidly permeable in the substratum. These soils are on the escarpments and sides of high stream benches. They formed in fine textured lacustrine sediments 20 to 40 inches deep over stratified silt and sand. The native vegetation was deciduous trees. Slope ranges from 18 to 30 percent.

Medary Variant soils commonly are adjacent to Caneek, Dorchester, and Zwingle soils. Caneek and Dorchester soils formed in silty alluvial material on bottom land below the Medary Variant soils. The poorly drained Zwingle soils are on benches above the Medary Variant soils. Their B horizon is grayer than that of the Medary Variant soils.

Typical pedon of Medary Variant silt loam, 18 to 30 percent slopes, 560 feet south and 2,210 feet west of the northeast corner of sec. 36, T. 93 N., R. 3 W.

A1—0 to 5 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; friable; medium acid; abrupt smooth boundary.

B1—5 to 11 inches; brown (7.5YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; medium acid; clear smooth boundary.

B21t—11 to 18 inches; reddish brown (5YR 4/4) silty clay; moderate very fine angular blocky structure; very firm; thick discontinuous dark reddish gray (5YR 4/2) clay flows; strongly acid; clear smooth boundary.

B22t—18 to 25 inches; reddish brown (5YR 4/4) silty clay; strong fine angular blocky structure; very firm; thick discontinuous dark reddish gray (5YR 4/2) clay flows; strongly acid; clear smooth boundary.

B3t—25 to 31 inches; brown (7.5YR 5/4) silty clay; few medium distinct reddish brown (5YR 4/4) and yellowish red (5YR 5/6) mottles; moderate medium subangular and angular blocky structure; firm; medium acid; abrupt wavy boundary.

C1—31 to 43 inches; yellowish brown (10YR 5/4) silt loam; few medium distinct reddish brown (5YR 4/4) mottles; massive; friable; few dark concretions (manganese oxide); neutral; abrupt wavy boundary.

C2—43 to 60 inches; yellowish brown (10YR 5/4), brownish yellow (10YR 6/6), and grayish brown (10YR 5/2) stratified coarse silt and fine sand; massive; friable; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 25 to 40 inches. The depth to stratified coarse silt and fine sand ranges from 20 to 40 inches. Carbonates are leached to a depth of 30 inches.

The A1 horizon typically is silt loam but in some pedons is silty clay loam. It is 3 to 6 inches thick. It is very dark gray (10YR 3/1), dark grayish brown (10YR 4/2), or dark gray (10YR 4/1). Some pedons have an A2 horizon, which is less than 5 inches thick. The B horizon has hue of 5YR, 2.5YR, or 7.5YR, value of 4 to 6, and chroma of 3 to 6. The B2 horizon is clay or silty clay.

The C horizon is dominantly stratified coarse silt and fine sand but has strata of silt loam or silty clay loam.

Mottland series

The Mottland series consists of well drained soils. Permeability is moderate in the upper part and moderately rapid in the substratum. These soils are on upland ridges and side slopes. They formed in loess or loamy sediments 7 to 20 inches deep over material weathered from limestone. The native vegetation was grasses. Slope ranges from 5 to 18 percent.

Mottland soils commonly are adjacent to Frankville and Luana soils. Frankville soils are underlain by hard limestone bedrock at a depth of 20 to 30 inches. They are on side slopes below the Mottland soils. Luana soils formed in 20 to 40 inches of loess and in the underlying residuum of limestone. They are on side slopes above the Mottland soils.

Typical pedon of Mottland silt loam, 5 to 14 percent slopes, moderately eroded, in a cultivated field; 50 feet east and 1,620 feet north of the southwest corner of sec. 11, T. 95 N., R. 5 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; about 5 percent soft limestone fragments; neutral; weak effervescence because of the limestone fragments; abrupt smooth boundary.

AC—6 to 9 inches; mixed dark brown (10YR 3/3) and brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; friable; about 10 percent soft limestone fragments; strong effervescence; mildly alkaline; abrupt wavy boundary.

IIC1—9 to 20 inches; brownish yellow (10YR 6/6) channery sandy loam; massive; friable; about 20 percent hard limestone fragments; violent effervescence; mildly alkaline; gradual smooth boundary.

IIC2—20 to 60 inches; yellow (10YR 7/6) channery sandy loam; massive; friable; about 35 percent hard limestone fragments; violent effervescence; mildly alkaline.

The thickness of the solum, or the depth to material weathered from limestone, ranges from 7 to 20 inches. Free carbonates typically are in all horizons, except for the Ap horizon, which is neutral in most pedons.

The Ap or A1 horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The content of coarse fragments is 3 to 10 percent in the Ap or A1 horizon and 5 to 20 percent in the AC horizon. The IIC horizon typically is channery sandy loam but ranges to channery silt loam. It has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 4 to 8. It is mildly alkaline or moderately alkaline and is strongly effervescent or violently effervescent. The content of hard limestone fragments in this horizon ranges from 10 to 40 percent.

Nordness series

The Nordness series consists of well drained, moderately permeable soils on upland ridges and side slopes. These soils formed in 5 to 18 inches of loamy or silty material and in a thin layer of clayey limestone residuum (fig. 19). The native vegetation was deciduous trees. Slope ranges from 2 to 25 percent.

Nordness soils commonly are adjacent to Backbone, Dubuque, Fayette, and Winneshiek soils. Backbone soils are underlain by limestone bedrock at a depth of 20 to 40 inches. They are on side slopes above the Nordness soils. Dubuque and Winneshiek soils also are on side slopes above the Nordness soils. They are underlain by limestone bedrock at a depth of 20 to 30 inches. Fayette soils are not underlain by limestone bedrock within a depth of 60 inches. They are on ridges and side slopes above the Nordness soils.

Typical pedon of Nordness silt loam, 2 to 5 percent slopes, in a wooded area used as pasture; 750 feet north and 400 feet west of the center of sec. 34, T. 94 N., R. 6 W.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A2—2 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak thin platy structure parting to weak fine subangular blocky; friable; medium acid; clear smooth boundary.

B1—6 to 11 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; common limestone fragments; medium acid; abrupt wavy boundary.

IIB2t—11 to 16 inches; dark brown (10YR 3/3) clay; weak very fine subangular blocky structure; very firm; thick continuous dark brown (7.5YR 3/2) clay films; common limestone fragments; slightly acid; abrupt wavy boundary.

IIR—16 to 18 inches; limestone bedrock that is weathered along fractures and is interbedded with residuum.

The solum ranges from 8 to 20 inches in thickness. It is neutral to medium acid.

The A1 horizon is very dark gray (10YR 3/1), dark gray (10YR 4/1), or very dark grayish brown (10YR 3/2). It is 1 to 4 inches thick. The Ap horizon is dark grayish brown (10YR 4/2). The A1 and A2 horizons typically are silt loam but in some pedons are loam. The IIB2t horizon is clay or silty clay. It is 1 to 5 inches thick.

Figure 19.—An area of Nordness soils, which formed in loess over fractured limestone bedrock.

Olin series

The Olin series consists of well drained soils that are moderately rapidly permeable in the upper part and moderately permeable in the lower part. These soils are on upland ridges and side slopes. They formed in 20 to 36 inches of moderately coarse textured material and in the underlying loamy glacial till. The native vegetation was grasses. Slope ranges from 2 to 9 percent.

Olin soils are similar to Kenyon soils and commonly are adjacent to Kenyon, Lilah, Rockton, and Sparta soils. Kenyon soils contain less sand in the A horizon and in the upper part of the B horizon than the Olin soils, and Lilah soils contain more sand in the lower part of the B horizon and in the C horizon. Rockton soils are underlain by limestone bedrock. Sparta soils formed in more than 60 inches of coarse textured material. Kenyon, Lilah, and Sparta soils are in positions on the landscape similar to those of the Olin soils, and Rockton soils are on side slopes below the Olin soils.

Typical pedon of Olin fine sandy loam, 2 to 5 percent slopes, in a cultivated field; 2,315 feet south and 930 feet west of the northeast corner of sec. 6, T. 91 N., R. 6 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—8 to 13 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

A3—13 to 20 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

B21—20 to 28 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; very friable; medium acid; clear smooth boundary.

IIB22—28 to 36 inches; yellowish brown (10YR 5/6) loam; weak medium subangular blocky structure; friable; stone line at 28 inches; medium acid; clear smooth boundary.

IIB23—36 to 46 inches; yellowish brown (10YR 5/6) loam; few fine distinct strong brown (7.5YR 5/6) and few fine faint brown (10YR 5/3) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; medium acid; clear smooth boundary.

IIB3—46 to 54 inches; yellowish brown (10YR 5/4) loam; few fine distinct strong brown (7.5YR 5/8) and brown (10YR 5/3) mottles; weak medium prismatic structure; firm; medium acid; clear smooth boundary.

IIC—54 to 60 inches; yellowish brown (10YR 5/4 and 5/6) loam; few fine distinct brown (10YR 5/3) mottles; massive; firm; common dark concretions (manganese oxide); medium acid.

The thickness of the solum ranges from 40 to 60 inches. The depth to glacial till ranges from 20 to 36 inches. The depth to carbonates ranges from 50 to 80 inches.

The Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The A horizon is fine sandy loam or sandy loam 14 to 24 inches thick. The upper part of the B2 horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/4). It is dominantly sandy loam but in some pedons has layers of loamy sand 6 to 8 inches thick. The IIB horizon is dark yellowish brown (10YR 4/4) or yellowish brown (10YR 5/4 or 5/6). It has few or common mottles. It is loam, clay loam, or sandy clay loam.

Oran series

The Oran series consists of somewhat poorly drained, moderately permeable soils on broad upland ridges. These soils formed in loamy material and in the underlying glacial till. The native vegetation was mixed grasses and trees. Slope ranges from 0 to 2 percent.

Oran soils commonly are adjacent to Bassett, Clyde, and Floyd soils. The moderately well drained Bassett soils are higher on the landscape than the Oran soils. Also, the upper part of their B horizon is browner. Clyde and Floyd soils are on concave slopes below the Oran soils. Their A horizon is thicker and darker than that of the Oran soils, and their IIB horizon is more friable.

Typical pedon of Oran loam, 0 to 2 percent slopes, in a cultivated field; 792 feet south and 1,350 feet east of the center of sec. 5, T. 91 N., R. 6 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; few black (10YR 2/1) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A2—8 to 13 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak thin platy structure; friable; medium acid; clear smooth boundary.

B1—13 to 20 inches; grayish brown (2.5Y 5/2) loam; common fine distinct yellowish brown (10YR 5/4) and few fine distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

IIB21t—20 to 25 inches; mixed grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) loam; few fine distinct brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; thin nearly continuous silt coatings, light gray (10YR 7/1) dry; thin discontinuous brown (7.5YR 4/4) clay films; strongly acid; clear smooth boundary.

IIB22—25 to 32 inches; mixed light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/8) loam; few fine distinct reddish brown (5YR 4/4) mottles; moderate fine subangular blocky structure; firm; nearly continuous silt coatings, white (10YR 8/1) dry; slightly acid; clear smooth boundary.

IIB3—32 to 41 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) loam; weak fine prismatic structure parting to weak fine subangular blocky; firm; thin discontinuous silt coatings, white (10YR 8/1) dry; slightly acid; clear smooth boundary.

IIC—41 to 60 inches; mottled light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) loam; massive; friable; thin discontinuous silt coatings, white (10YR 8/1) dry; slightly acid.

The thickness of the solum typically is more than 40 inches but ranges from 36 to 50 inches. The Ap horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2). The A2 horizon is dark grayish brown (10YR 4/2 or 2.5Y 4/2) or brown (10YR 4/3 or 5/3). The B1 horizon is grayish brown (2.5Y 5/2), dark grayish brown (10YR 4/2 or 2.5Y 4/2), or brown (10YR 5/3). It commonly has a stone line at a depth of 14 to 24 inches. The IIB horizon is mottled with hue of 2.5Y, 10YR, or 7.5YR, value of 4 to 6, and chroma of 2 to 8. It is dominantly loam but in some pedons has thin layers of clay loam.

Orion series

The Orion series consists of somewhat poorly drained, moderately permeable soils on narrow bottom land and

in upland drainageways. These soils formed in stratified, silty sediments 20 to 40 inches deep over a dark buried soil. The native vegetation was trees. Slope ranges from 0 to 5 percent.

Orion soils commonly are adjacent to Arenzville, Chaseburg, and Exette soils. Arenzville and Chaseburg soils are in the higher lying areas on the bottom land and are better drained than the Orion soils. Also, their C horizon is browner. Exette soils formed in loess and are not stratified. They are on side slopes above the Orion soils.

Typical pedon of Orion silt loam, 2 to 5 percent slopes, in a cultivated field; 1,588 feet east and 680 feet north of the center of sec. 3, T. 92 N., R. 5 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam stratified with thin dark gray (10YR 4/1) layers; light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; common dark concretions (iron and manganese oxide); neutral; abrupt smooth boundary.

C1—7 to 20 inches; stratified dark grayish brown (10YR 4/2), dark gray (10YR 4/1), and gray (10YR 5/1) silt loam; massive; very friable; common dark concretions (iron and manganese oxide); neutral; clear smooth boundary.

C2—20 to 29 inches; stratified dark gray (10YR 4/1), dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2), and gray (10YR 5/1) silt loam; massive; very friable; common dark concretions (manganese oxide); neutral; abrupt smooth boundary.

Ab—29 to 49 inches; black (N 2/0) silt loam; weak fine granular structure; friable; neutral; clear smooth boundary.

C3—49 to 60 inches; dark gray (10YR 4/1) silt loam; few fine distinct light olive brown (2.5Y 5/4) mottles; massive; friable; neutral.

The depth to the Ab horizon ranges from 20 to 40 inches. The content of clay generally ranges from 10 to 15 percent in the 10- to 40-inch control section. In some pedons, however, it is more than 18 percent in the Ab horizon. Reaction typically is neutral throughout the profile, but in some pedons the Ab horizon is slightly acid. The color, arrangement, and thickness of all horizons vary, depending on the source of the sediments and the method of deposition.

The Ap or A1 horizon is dominantly dark grayish brown (10YR 4/2) but has strata with value of 3 to 5 and chroma of 1 to 3. The C horizon is dominantly dark grayish brown (10YR 4/2) or dark gray (10YR 4/1) but generally has thin strata that are gray (10YR 5/1), very dark grayish brown (10YR 3/2), or brown (10YR 5/3). The Ab horizon is neutral in hue or has hue of 10YR or 2.5Y. It has value of 2 or 3 and chroma of 0 to 2. It generally is more than 10 inches thick.

Orwood series

The Orwood series consists of well drained, moderately permeable soils on upland ridges and side slopes. These soils formed in medium textured eolian material. The native vegetation was mixed grasses and trees. Slope ranges from 2 to 18 percent.

Orwood soils are similar to Bassett, Downs, and Fayette soils and commonly are adjacent to Downs and Lamont soils. Their positions on the landscape are similar to those of the similar and adjacent soils. Bassett soils formed in loamy sediments and the underlying glacial till and contain more sand throughout than the Orwood soils. Downs and Fayette soils formed in loess and contain less sand throughout the solum than the Orwood soils. Lamont soils contain more sand than the Orwood soils. Also, their A1 horizon is thinner and their A2 horizon more distinct.

Typical pedon of Orwood silt loam, 2 to 5 percent slopes, in a cultivated field; 80 feet north and 190 feet east of the center of sec. 5, T. 91 N., R. 6 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

B1—8 to 13 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21—13 to 18 inches; yellowish brown (10YR 5/4) silt loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B22t—18 to 29 inches; yellowish brown (10YR 5/6) loam; weak fine subangular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay films; friable; medium acid; clear smooth boundary.

B31—29 to 38 inches; yellowish brown (10YR 5/4) loam that has lenses of strong brown (7.5YR 5/6) fine sand; weak fine prismatic structure parting to weak fine subangular blocky; friable; medium acid; gradual smooth boundary.

B32—38 to 56 inches; yellowish brown (10YR 5/4) loam that has lenses of strong brown (7.5YR 5/6) fine sand in the lower part; weak fine prismatic structure; friable; strongly acid; clear smooth boundary.

C—56 to 60 inches; yellowish brown (10YR 5/4) loam that has lenses of yellowish brown (10YR 5/4) fine sand; few fine faint grayish brown (10YR 5/2) mottles; massive; friable; medium acid.

The thickness of the solum ranges from 40 to 60 inches. The A horizon typically is silt loam but in some pedons is loam. The Ap horizon or A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. Some pedons have an A2 horizon, which is dark grayish brown (10YR 4/2) or

brown (10YR 4/3). In most cultivated areas, this horizon is incorporated into the Ap horizon. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is silt loam, loam, or clay loam. The content of clay in this horizon ranges from 24 to 30 percent. The B2t horizon has no mottles of low chroma, but in many pedons the B3 and C horizons have fine faint mottles.

Ossian series

The Ossian series consists of poorly drained, moderately permeable soils on bottom land, the lower parts of upland drainageways, and low stream benches. These soils formed in silty alluvium. The native vegetation was water-tolerant grasses. Slope ranges from 0 to 2 percent.

Ossian soils are similar to Otter and Rowley soils and commonly are adjacent to those soils and to Colo, Kennebec, and Richwood soils. Otter and Colo soils are in positions on bottom land similar to those of the Ossian soils. Their A horizon is thicker than that of the Ossian soils. The somewhat poorly drained Kennebec and Rowley and well drained Richwood soils are in the higher lying areas on the stream benches or the bottom land. The upper part of their B horizon is browner than that of the Ossian soils. Also, Kennebec soils have a thicker A horizon.

Typical pedon of Ossian silt loam, 0 to 2 percent slopes, in a permanent pasture; 1,490 feet north and 63 feet east of the southwest corner of sec. 8, T. 94 N., R. 5 W.

A11—0 to 6 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; few dark concretions (iron oxide); neutral; clear smooth boundary.

A12—6 to 12 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

A13—12 to 15 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; few fine faint dark grayish brown (2.5Y 4/2) mottles; weak very fine and fine subangular blocky structure; friable; few dark concretions (manganese oxide); neutral; clear smooth boundary.

B1g—15 to 20 inches; dark gray (10YR 4/1) silt loam; few fine distinct grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; few dark concretions (iron and manganese oxide); neutral; clear smooth boundary.

B21g—20 to 29 inches; olive gray (5Y 5/2) silt loam; few discontinuous dark gray (5Y 4/1) coatings on faces of peds; common fine distinct olive yellow (2.5Y 6/6) and few fine faint light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; common dark concretions (manganese oxide); neutral; gradual smooth boundary.

B22g—29 to 41 inches; olive gray (5Y 5/2) silt loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few dark concretions (manganese oxide); neutral; clear smooth boundary.

B3g—41 to 49 inches; olive gray (5Y 5/2) silt loam; weak fine prismatic structure; friable; common dark concretions (iron and manganese oxide); neutral; clear smooth boundary.

Cg—49 to 60 inches; olive gray (5Y 5/2) silt loam; few fine distinct strong brown (7.5YR 5/6) mottles; massive; friable; few dark concretions (iron and manganese oxide); neutral.

The thickness of the solum ranges from 36 to 50 inches. The A1 horizon is black (10YR 2/1, N 2/0, or 5Y 2/1) or very dark gray (10YR 3/1). It is 12 to 20 inches thick. The B1g horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 or 2. The B1g and B2g horizons are silt loam or silty clay loam in which the content of clay ranges from 22 to 28 percent. The B2g and B3g horizons have hue of 5Y, value of 4 to 6, and chroma of 1 or 2.

Otter series

The Otter series consists of poorly drained, moderately permeable soils on bottom land and in upland drainageways. These soils formed in silty alluvium. The native vegetation was water-tolerant grasses. Slope ranges from 0 to 4 percent.

Otter soils are similar to Colo and Ossian soils and commonly are adjacent to Huntsville, Kennebec, Ossian, Palms, and Worthen soils. The A horizon of Colo soils has a higher content of clay than that of the Otter soils. Ossian soils are in positions on the landscape similar to those of the Otter soils. Their A horizon is thinner than that of the Otter soils. Huntsville and Worthen soils are well drained. Their B horizon is browner than that of the Otter soils. Kennebec soils are somewhat poorly drained. The upper part of their B horizon is browner than that of the Otter soils. Palms soils formed in organic material. They are in depressional areas below the Otter soils. Huntsville and Kennebec soils are in the higher lying areas on bottom land. Worthen soils are on foot slopes adjacent to the upland drainageways.

Typical pedon of Otter silt loam, in a pastured area of Otter-Worthen silt loams, 1 to 4 percent slopes, 740 feet west and 125 feet south of the northeast corner of sec. 36, T. 95 N., R. 6 W.

A11—0 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few dark concretions (iron and manganese oxide); slightly acid; clear smooth boundary.
A12—8 to 15 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; few dark concretions (iron oxide); slightly acid; clear smooth boundary.
A13—15 to 21 inches; black (N 2/0) silt loam, very dark gray (N 3/0) dry; weak very fine granular structure; friable; slightly acid; clear smooth boundary.
A14—21 to 31 inches; black (10YR 2/1) and very dark gray (10YR 3/1) silt loam, very dark gray (10YR 3/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine granular structure; friable; neutral; clear smooth boundary.
C1g—31 to 39 inches; dark gray (5Y 4/1) silt loam; common fine distinct light olive brown (2.5Y 5/6) mottles; massive; friable; neutral; clear smooth boundary.
C2g—39 to 60 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) silt loam; massive; friable; many dark concretions (manganese oxide); neutral.

The A horizon, or the solum, ranges from 24 to 40 inches in thickness. It is black (N 2/0 or 10YR 2/1) or very dark gray (10YR 3/1). It is dominantly silt loam but in some pedons has thin strata of silty clay loam. The C horizon has hue of 5Y to 10YR, value of 4 or 5, and chroma of 0 to 2. It is dominantly silt loam but in some pedons has strata of silty clay loam or sandy loam.

Palms series

The Palms series consists of very poorly drained soils in seepy areas on hillsides or in depressions on uplands. Permeability is moderately slow to moderately rapid. These soils formed in organic material 18 to 52 inches deep over alluvial or glacial sediments. The native vegetation was grasses, sedges, and other water-tolerant plants. Slope ranges from 1 to 4 percent.

Palms soils commonly are adjacent to the poorly drained Clyde and Otter soils in the higher lying areas. These adjacent soils did not form in organic material.

Typical pedon of Palms muck, 1 to 4 percent slopes, in a cultivated field; 1,290 feet west and 520 feet north of the southeast corner of sec. 17, T. 95 N., R. 6 W.

Oap—0 to 8 inches; black (10YR 2/1, broken face and rubbed) sapric material, black (N 2/0) dry; about 5 percent fiber, a trace rubbed; weak fine subangular blocky structure parting to weak very fine granular; slightly sticky; fibers are herbaceous; about 30 percent mineral material; neutral; abrupt smooth boundary.
Oa2—8 to 24 inches; black (N 2/0, broken face and rubbed) sapric material, black (N 2/0) dry; about 5 percent fiber, less than 5 percent rubbed; weak thin platy structure; slightly sticky; fibers are herbaceous; about 10 to 15 percent mineral material; neutral; abrupt wavy boundary.
IIC1g—24 to 29 inches; very dark gray (N 3/0) silty clay loam; massive; firm; neutral; clear smooth boundary.
IIC2g—29 to 60 inches; greenish gray (5GY 5/1) silty clay loam; few fine distinct strong brown (7.5YR 5/6) and light olive brown (2.5Y 5/4) mottles; massive; friable; neutral.

The sapric material generally ranges from 18 to 40 inches in thickness, but in some pedons it is as much as 52 inches thick. It is black (N 2/0 or 10YR 2/1) or very dark brown (10YR 2/2). The IICg horizon has hue of 10YR to 5GY, value of 3 to 5, and chroma of 0 to 2. It generally is silty clay loam, loam, or silt loam but has sandy strata in some pedons. It is neutral or slightly acid.

Richwood series

The Richwood series consists of well drained soils that are moderately permeable in the upper part and are rapidly permeable in the lower part of the substratum. These soils are on stream benches. They formed in silty alluvium underlain by loamy and sandy alluvium. The native vegetation was grasses. Slope ranges from 0 to 2 percent.

These soils are taxadjuncts to the Richwood series because the IIC horizon lacks the development characteristic of a solum and contains less sand than is defined as the range for the series. These differences, however, do not significantly affect the use or behavior of the soils.

Richwood soils are similar to Tama soils and commonly are adjacent to Festina, Ossian, and Rowley soils. Tama soils have a C horizon that is silt loam throughout. Festina soils are in positions on the landscape similar to those of the Richwood soils. Their A horizon is thinner than that of the Richwood soils. The poorly drained Ossian and somewhat poorly drained Rowley soils are in the lower lying areas on the stream benches. Their B horizon is grayer than that of the Richwood soils.

Typical pedon of Richwood silt loam, 0 to 2 percent slopes, in a cultivated field; 2,518 feet east and 364 feet north of the southwest corner of sec. 4, T. 92 N., R. 6 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A12—8 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
A3—16 to 20 inches; dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
B21—20 to 27 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
B22t—27 to 35 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay films; medium acid; clear smooth boundary.
B3—35 to 45 inches; yellowish brown (10YR 5/4) silt loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few dark concretions (iron and manganese oxide); thin discontinuous silt coatings, light gray (10YR 7/1) dry; medium acid; clear smooth boundary.
C1—45 to 52 inches; yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) silt loam; massive; friable; few dark concretions (manganese oxide); medium acid; abrupt wavy boundary.
IIC2—52 to 60 inches; mixed yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) sandy loam; single grained; loose; medium acid.

The thickness of the solum ranges from 40 to 60 inches. The A horizon is 14 to 24 inches thick. The A1 or Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B22t horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 5. It is silt loam or silty clay loam. It is slightly acid or medium acid. The IIC horizon is sandy loam, loam, or loamy sand. It has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6.

Rockton series

The Rockton series consists of well drained, moderately permeable soils on uplands. These soils formed in 20 to 40 inches of loamy material and in a thin layer of clayey limestone residuum. The native vegetation was grasses. Slope ranges from 2 to 5 percent.

Rockton soils are similar to Winneshiek soils and commonly are adjacent to Kenyon and Olin soils. Winneshiek soils have an A2 horizon. Their A1 horizon is thinner than that of the Rockton soils. Kenyon and Olin soils formed in loamy material and in the underlying glacial till. They are on convex side slopes above the Rockton soils.

Typical pedon of Rockton loam, 30 to 40 inches to limestone, 2 to 5 percent slopes, in a cultivated field; 1,470 feet west and 330 feet north of the center of sec. 7, T. 91 N., R. 6 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.
A12—7 to 13 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.
A3—13 to 17 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.
B21—17 to 23 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; medium acid; clear smooth boundary.
B22t—23 to 30 inches; brown (7.5YR 4/4) clay loam; moderate fine subangular blocky structure; friable; medium acid; clear smooth boundary.
IIB23t—30 to 33 inches; brown (7.5YR 4/4) clay; moderate fine subangular blocky structure; very firm; nearly continuous dark brown (7.5YR 3/2) clay films; slightly acid; abrupt wavy boundary.
IIR—33 inches; hard, fractured limestone bedrock that is level and bedded.

The thickness of the solum, or the depth to limestone bedrock, ranges from 20 to 40 inches. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 10 to 18 inches thick. It typically is loam but in some pedons is silt loam. The B2 horizon has hue of 10YR in the upper part and 7.5YR or 10YR in the lower part. It has value of 4 or 5 and chroma of 3 or 4. It is loam or clay loam in which the content of clay ranges from 25 to 35 percent. In some pedons the only evidence of the IIB horizon is thin rinds around flaggy limestone fragments. In other pedons this horizon is as much as 6 inches thick. It is clay loam, clay, or silty clay.

Rowley series

The Rowley series consists of somewhat poorly drained, moderately permeable soils on stream benches. These soils formed in silty alluvium underlain by stratified, silty and sandy alluvium. The native vegetation was grasses. Slope ranges from 0 to 2 percent.

These soils are taxadjuncts to the Rowley series because the stratified IIC horizon lacks the development characteristic of a solum. This difference, however, does not significantly affect the use or behavior of the soils.

Rowley soils are similar to Ossian soils and commonly are adjacent to Canoe, Ossian, and Richwood soils. The poorly drained Ossian soils are in the lower lying areas on the stream benches. The upper part of their B horizon is grayer than that of the Rowley soils. Canoe soils have

an A2 horizon. Their A1 horizon is thinner than that of the Rowley soils. Their positions on the landscape are similar to those of the Rowley soils. The well drained Richwood soils are in the higher lying areas on the stream benches. The upper part of their B horizon is browner than that of the Rowley soils.

Typical pedon of Rowley silt loam, 0 to 2 percent slopes, in a cultivated field; 38 feet south and 2,539 feet west of the northeast corner of sec. 16, T. 92 N., R. 6 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.

A12—8 to 13 inches; black (10YR 2/1) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

A3—13 to 19 inches; very dark gray (10YR 3/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B1—19 to 23 inches; dark grayish brown (10YR 4/2) silt loam; few fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21—23 to 28 inches; grayish brown (10YR 5/2) silt loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few dark concretions (manganese oxide); slightly acid; gradual smooth boundary.

B22t—28 to 36 inches; grayish brown (2.5Y 5/2) silt loam; few fine distinct strong brown (7.5YR 5/8) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B3—36 to 49 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; friable; few dark reddish concretions (iron oxide); neutral; clear smooth boundary.

IIC—49 to 60 inches; stratified grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/8) silt loam and loamy sand; massive; friable; common dark reddish concretions (iron oxide); neutral.

The thickness of the solum ranges from 45 to 60 inches. The Ap or A1 horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). It is 10 to 20 inches thick. The B1 horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. The B2 horizon is silt loam or silty clay loam in which the content of clay ranges from 24 to 29 percent. It is slightly acid or medium acid. The IIC horizon generally is silt loam stratified with loamy sand, sandy loam, or sand.

Saude series

The Saude series consists of well drained soils that are moderately permeable in the upper part and rapidly permeable in the lower part. These soils are on stream benches. They formed in 24 to 32 inches of loamy material and in the underlying coarse sand and gravel. The native vegetation was grasses. Slope ranges from 0 to 5 percent.

Saude soils are similar to Flagler, Wapsie, and Waukee soils and commonly are adjacent to those soils and to Lawler soils. Flagler, Wapsie, and Waukee soils are in positions on the landscape similar to those of the Saude soils. The A horizon of Flagler soils contains more sand than that of the Saude soils. The A horizon of Wapsie soils is thinner than that of the Saude soils. Waukee soils are underlain by sand and gravel at a depth of 32 to 40 inches. The somewhat poorly drained Lawler soils are in the lower lying areas on the stream benches. The upper part of their B horizon is grayer than that of the Saude soils.

Typical pedon of Saude loam, 0 to 2 percent slopes, in a cultivated field; 2,030 feet west and 317 feet north of the southeast corner of sec. 4, T. 92 N., R. 6 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine granular; friable; neutral; abrupt smooth boundary.

A12—8 to 13 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B1—13 to 17 inches; dark brown (10YR 3/3) loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B2—17 to 24 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B31—24 to 29 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; friable; medium acid; abrupt wavy boundary.

IIB32—29 to 37 inches; brown (7.5YR 4/4) gravelly loamy sand; single grained; loose; few pebbles 1 to 2 inches in diameter; strongly acid; clear smooth boundary.

IIC—37 to 60 inches; strong brown (7.5YR 5/6) gravelly sand; single grained; loose; strongly acid.

The thickness of the solum ranges from 24 to 40 inches. The depth to sand and gravel is 24 to 32 inches.

The A horizon is 11 to 16 inches thick. The Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The B2 and B3 horizons have hue of 10YR, value of 4 or 5, and chroma of 3, 4, or 6. The B2 horizon is loam in which the content of clay ranges from 12 to 20 percent. The B horizon typically is slightly acid to strongly acid.

The IIC horizon is sand, coarse sand, or gravelly sand. The content of gravel in this horizon generally is 5 to 15 percent, but in some strata it is 20 to 50 percent.

Sparta series

The Sparta series consists of excessively drained, rapidly permeable soils on uplands and high stream benches. These soils formed in eolian sand. The native vegetation was grasses. Slope ranges from 2 to 12 percent.

Sparta soils commonly are adjacent to Marlean, Olin, and Terril soils. Marlean and Olin soils are in positions on the landscape similar to those of the Sparta soils. Marlean soils formed in loamy material over limestone residuum. Olin soils formed in loamy material and in the underlying glacial till. Terril soils are on foot slopes below the Sparta soils. They contain less sand throughout than the Sparta soils. Also, their A horizon is thicker.

Typical pedon of Sparta loamy fine sand, 2 to 5 percent slopes, in a cultivated field; 54 feet north and 2,476 feet east of the center of sec. 6, T. 91 N., R. 6 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; medium acid; abrupt smooth boundary.

A12—8 to 14 inches; very dark brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; medium acid; clear smooth boundary.

A3—14 to 23 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; weak coarse subangular blocky structure; very friable; medium acid; clear smooth boundary.

B2—23 to 29 inches; brown (10YR 4/3) loamy fine sand; weak coarse subangular blocky structure; very friable; strongly acid; clear smooth boundary.

C1—29 to 52 inches; yellowish brown (10YR 5/4) sand and fine sand; single grained; loose; root hairs extending to 38 inches; strongly acid; clear smooth boundary.

C2—52 to 60 inches; light yellowish brown (10YR 6/4) sand and fine sand; single grained; loose; 1/4-inch brown (7.5YR 4/4) bands at 56 and 58 inches; strongly acid.

The solum ranges from 24 to 40 inches in thickness. It is medium acid or strongly acid.

The A horizon is 10 to 24 inches thick. It is loamy fine sand, loamy sand, or fine sand. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is fine sand, loamy sand, or loamy fine sand. The C horizon is sand and fine sand. It contains no gravel.

Spillville series

The Spillville series consists of moderately well drained and somewhat poorly drained, moderately permeable soils on bottom land. These soils formed in loamy alluvium. The native vegetation was grasses. Slope ranges from 0 to 2 percent.

Spillville soils are similar to Ankeny and Terril soils and commonly are adjacent to those soils and to Dorchester soils. Ankeny soils are on low stream benches and foot slopes above the Spillville soils. Their A horizon contains more sand and less clay than that of the Spillville soils. Terril soils are in the higher lying areas on foot slopes and alluvial fans. Their A horizon is thinner than that of the Spillville soils. Dorchester soils contain more silt and less sand throughout the solum than the Spillville soils. They are in the higher lying areas on bottom land.

Typical pedon of Spillville loam, 0 to 2 percent slopes, in a cultivated field; 470 feet east and 705 feet south of the center of sec. 6, T. 92 N., R. 4 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine granular; friable; neutral; abrupt smooth boundary.

A12—7 to 23 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure parting to weak very fine granular; friable; neutral; gradual smooth boundary.

A13—23 to 37 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A14—37 to 48 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

C—48 to 60 inches; very dark grayish brown (10YR 3/2) sandy loam; massive; friable; few fine distinct very dark gray (10YR 3/1) mottles; neutral.

The solum ranges from 36 to 52 inches in thickness. It is neutral or slightly acid.

The A horizon is dominantly black (10YR 2/1) or very dark brown (10YR 2/2) but is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1) in the lower part. It typically is loam, but the range includes silt loam high in content of sand. The C horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It is dominantly loam or sandy loam but in some pedons has strata of loamy sand. It has few to many mottles.

Tama series

The Tama series consists of well drained, moderately permeable soils on loess-covered uplands. These soils

formed in loess. The native vegetation was grasses. Slope ranges from 2 to 9 percent.

Tama soils are similar to Richwood soils and commonly are adjacent to Atterberry, Downs, and Worthen soils. The substratum of Richwood soils is coarser textured than that of the Tama soils. Atterberry soils are on broad ridges above the Tama soils. Their B horizon is grayer than that of the Tama soils. Downs soils are in positions on the landscape similar to those of the Tama soils. Their A1 horizon is thinner than that of the Tama soils. Worthen soils are near waterways and are lower on the landscape than the Tama soils. Also, their A horizon is thicker.

Typical pedon of Tama silt loam, 2 to 5 percent slopes (fig. 20), in a cultivated field; 2,070 feet west and 25 feet north of the center of sec. 26, T. 94 N., R. 4 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A12—8 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak very fine and fine subangular blocky structure; friable; neutral; clear smooth boundary.

A3—12 to 19 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak very fine and fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21t—19 to 24 inches; brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; thin discontinuous very dark grayish brown (10YR 3/2) clay films; medium acid; clear smooth boundary.

B22t—24 to 34 inches; yellowish brown (10YR 5/4) silty clay loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; thin discontinuous dark brown (10YR 3/3) clay films on prisms; strongly acid; gradual smooth boundary.

B31—34 to 42 inches; yellowish brown (10YR 5/6) silt loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; thin discontinuous yellowish brown (10YR 5/4) clay films; strongly acid; clear smooth boundary.

B32—42 to 52 inches; yellowish brown (10YR 5/4) silt loam; weak coarse prismatic structure; friable; discontinuous silt coatings, light gray (10YR 7/1) dry; medium acid; gradual smooth boundary.

C—52 to 60 inches; yellowish brown (10YR 5/4) silt loam; massive; friable; few fine faint grayish brown (10YR 5/2) mottles; common concretions (manganese oxide); medium acid.

Figure 20.—Profile of Tama silt loam. This soil has a dark surface layer.

The thickness of the solum ranges from 36 to 60 inches. The A horizon is 12 to 20 inches thick. The Ap or A1 horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). It is silt loam or silty clay loam. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The B2t horizon is

silty clay loam in which the content of clay ranges from 28 to 34 percent. The B3 and C horizons have few mottles or are not mottled.

Terril series

The Terril series consists of moderately well drained soils that are moderately permeable in the upper part and rapidly permeable in the substratum. These soils are on foot slopes and alluvial fans. They formed in loamy alluvium. The native vegetation was grasses. Slope ranges from 2 to 5 percent.

Terril soils are similar to Spillville soils and commonly are adjacent to Ankeny, Sparta, and Spillville soils. Ankeny and Spillville soils are on bottom land below the Terril soils. The A horizon of Ankeny soils contains more sand and less clay than that of the Terril soils. The A horizon of Spillville soils is thicker than that of the Terril soils. Sparta soils commonly are on uplands above the Terril soils. Their solum contains more sand and less clay throughout than that of the Terril soils. Also, their A horizon is thinner.

Typical pedon of Terril loam, sandy substratum, 2 to 5 percent slopes, 330 feet north and 1,470 feet west of the southeast corner of sec. 14, T. 93 N., R. 5 W.

A11—0 to 14 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure parting to weak fine subangular blocky; friable; neutral; clear smooth boundary.

A12—14 to 23 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on faces of peds; weak fine granular structure parting to weak fine subangular blocky; friable; neutral; clear smooth boundary.

A3—23 to 27 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B2—27 to 36 inches; brown (10YR 4/3) loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B31—36 to 42 inches; yellowish brown (10YR 5/4) loam; weak medium prismatic structure; friable; neutral; clear smooth boundary.

B32—42 to 49 inches; dark yellowish brown (10YR 4/4) loam; weak medium prismatic structure; friable; neutral; clear smooth boundary.

C—49 to 60 inches; yellowish brown (10YR 5/4) loamy sand; single grained; loose; stratum of sandy loam at 52 inches; neutral.

The solum ranges from about 36 to 60 inches in thickness. It is neutral or slightly acid.

The A horizon is 24 to 36 inches thick. It is black (10YR 2/1) or very dark brown (10YR 2/2) in the upper part and very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) in the lower part. It typically is loam, but the range includes silt loam and clay loam. The B horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. It typically is loam, but the range includes clay loam. In some pedons the lower part of the B3 horizon and the C horizon have a few faint mottles. The C horizon is loamy sand or gravelly sand.

Volney series

The Volney series consists of well drained and somewhat excessively drained soils. Permeability is moderately rapid in the upper part and very rapid in the substratum. These soils are on alluvial fans and the lower parts of narrow upland drainageways. They formed in loamy alluvium that has varying amounts of limestone fragments (fig. 21). The native vegetation was grasses. Slope ranges from 2 to 12 percent.

Volney soils are similar to Marlean soils and commonly are adjacent to Dorchester and Dubuque soils. The A horizon of Marlean soils is thinner than that of the Volney soils. Dorchester soils do not contain coarse fragments of limestone and are more stratified than the Volney soils. Also, they are nearer the drainageways and lower on the landscape. Dubuque soils formed in loess and in a thin layer of limestone residuum. They are on uplands above the Volney soils.

Typical pedon of Volney channery silt loam, 5 to 12 percent slopes, 462 feet east and 132 feet south of the northwest corner of sec. 26, T. 93 N., R. 3 W.

A11—0 to 11 inches; very dark brown (10YR 2/2) channery silt loam, very dark grayish brown (10YR 3/2) dry; weak fine granular and weak fine subangular blocky structure; friable; about 25 percent channery limestone fragments; slight effervescence; mildly alkaline; clear smooth boundary.

A12—11 to 20 inches; black (10YR 2/1) channery silt loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; about 15 percent channery limestone fragments; slight effervescence; mildly alkaline; clear wavy boundary.

A13—20 to 29 inches; very dark brown (10YR 2/2) very flaggy silt loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; friable; about 60 percent flaggy limestone fragments; slight effervescence; mildly alkaline; gradual irregular boundary.

C—29 to 60 inches; mixed very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), and brown (10YR 4/3) flaggy silt loam; massive; friable; about 70 percent flaggy limestone fragments; slight effervescence; mildly alkaline.

Figure 21.—Profile of Volney channery silt loam, which formed in alluvium containing limestone fragments.

The solum, or the A1 horizon, ranges from 24 to 36 inches in thickness. It generally is black (10YR 2/1) or very dark brown (10YR 2/2) but in some pedons is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) in the lower part. It is mildly alkaline or moderately alkaline. It is channery or flaggy silt loam or channery loam in which the content of sand is 20 to 40 percent. The content of hard limestone fragments varies within short distances. It generally increases with increasing depth. It ranges, by volume, from 15 to 30 percent in the upper part of the A horizon and is as much as 75 percent in the lower part.

Wapsie series

The Wapsie series consists of well drained soils that are moderately permeable in the upper part and very rapidly permeable in the lower part. These soils are on stream benches. They formed in 24 to 32 inches of loamy material and in the underlying coarse sand and gravel. The native vegetation was mixed grasses and trees. Slope ranges from 0 to 5 percent.

Wapsie soils are similar to Saude soils and commonly are adjacent to Lawler, Saude, and Waukee soils. Their A horizon is thinner than that of the adjacent soils. Lawler soils are in the lower lying areas on the stream benches. Their B horizon is grayer than that of the Wapsie soils. Saude and Waukee soils are in positions on the landscape similar to those of the Wapsie soils. Waukee soils are deeper to the coarse sand and gravel than the Wapsie soils.

Typical pedon of Wapsie loam, 0 to 2 percent slopes, in a cultivated field; 1,564 feet east and 848 feet south of the northwest corner of sec. 16, T. 92 N., R. 5 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

B1—8 to 12 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B21t—12 to 17 inches; yellowish brown (10YR 5/4) loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak fine subangular blocky structure; friable; thin discontinuous dark brown (7.5YR 3/2) clay films; medium acid; clear smooth boundary.

B22t—17 to 25 inches; yellowish brown (10YR 5/4) loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak fine subangular blocky structure; friable; thin discontinuous dark brown (7.5YR 3/2) clay films; medium acid; clear smooth boundary.

IIB31t—25 to 29 inches; brown (7.5YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; dark brown (7.5YR 3/2) clay bridging; medium acid; clear smooth boundary.

IIB32t—29 to 38 inches; brown (7.5YR 4/4) gravelly loamy sand; single grained; loose; dark brown (7.5YR 3/2) clay bridging; medium acid; clear smooth boundary.

IIC—38 to 60 inches; brown (7.5YR 4/4) gravelly sand; single grained; loose; medium acid.

The thickness of the solum ranges from 24 to 40 inches. The depth to sand and gravel is 24 to 32 inches.

The Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The A1 horizon is very dark gray (10YR 3/1) or very dark brown (10YR 2/2). It is 6 to 9 inches thick. Some pedons have an A2 horizon, which has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 8. It is loam or sandy loam. The IIB3 horizon is sandy loam, loam, or sandy clay loam in the upper part and sandy loam or gravelly loamy sand in the lower part. The IIC horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. It is sand, coarse sand, or gravelly sand. The content of gravel in this horizon is dominantly 5 to 15 percent but in some strata is 20 to 50 percent.

Waukee series

The Waukee series consists of well drained soils that are moderately permeable in the upper part and very rapidly permeable in the substratum. These soils are on stream benches. They formed in loamy material 32 to 40 inches deep over sand and gravel. The native vegetation was grasses. Slope ranges from 0 to 2 percent.

Waukee soils are similar to Saude soils and commonly are adjacent to Lawler, Saude, and Wapsie soils. Saude and Wapsie soils are in positions on the landscape similar to those of the Waukee soils. They are underlain by sand and gravel at a depth of 24 to 32 inches. Also, the A horizon of Wapsie soils is thinner than that of the Waukee soils. The somewhat poorly drained Lawler soils are in the lower lying areas on the stream benches. The upper part of their B horizon is grayer than that of the Waukee soils.

Typical pedon of Waukee loam, 0 to 2 percent slopes, in a cultivated field; 880 feet east and 45 feet south of the center of sec. 9, T. 92 N., R. 6 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 11 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

A3—11 to 17 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B2—17 to 27 inches; dark yellowish brown (10YR 4/4) loam; brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B3—27 to 38 inches; yellowish brown (10YR 5/4) sandy clay loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; abrupt wavy boundary.

IIC1—38 to 44 inches; yellowish brown (10YR 5/6) sand; single grained; loose; slightly acid; abrupt wavy boundary.

IIC2—44 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grained; loose; strong brown (7.5YR 5/6) sandy loam bands in the lower part; neutral.

The thickness of the solum ranges from 30 to 48 inches. The A horizon is about 8 to 12 inches thick. The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It typically is loam, but the range includes silt loam. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is loam or sandy clay loam in which the content of clay ranges from 20 to 26 percent. In some pedons a layer of sandy loam is directly above the IIC horizon. This layer is less than 6 inches thick. The IIC horizon is coarse loamy sand, gravelly sand, or sand. The content of gravel in this horizon typically is about 10 to 20 percent, but in some pedons it is as much as 50 percent.

Winneshiek series

The Winneshiek series consists of well drained, moderately permeable soils on uplands. These soils formed in 20 to 30 inches of loamy material and in a thin layer of clayey limestone residuum. The native vegetation was mixed grasses and trees. Slope ranges from 2 to 9 percent.

Winneshiek soils are similar to Rockton soils and commonly are adjacent to Bassett, Goss, and Nordness soils. The A horizon of Rockton soils is thicker than that of the Winneshiek soils. Bassett soils formed in loamy sediments and in the underlying glacial till. They are on ridges above the Winneshiek soils. Goss soils formed in loamy sediments and in the underlying clayey residuum of limestone. They are on side slopes above the Winneshiek soils. Nordness soils are underlain by limestone bedrock within a depth of 20 inches. They are on side slopes below the Winneshiek soils.

Typical pedon of Winneshiek loam, 20 to 30 inches to limestone, 2 to 5 percent slopes, in a cultivated field; 1,188 feet north and 400 feet east of the southwest corner of sec. 24, T. 93 N., R. 5 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
B1—8 to 12 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
B21t—12 to 22 inches; dark yellowish brown (10YR 4/4) clay loam; brown (10YR 4/3) coatings on faces of peds; moderate fine subangular blocky structure; friable; thin discontinuous very dark grayish brown (10YR 3/2) clay films; neutral; abrupt wavy boundary.
IIB22t—22 to 27 inches; yellowish brown (10YR 5/6) clay; strong fine subangular blocky structure; very firm; thick discontinuous dark brown (7.5YR 3/2) clay films; neutral; abrupt wavy boundary.
IIR—27 inches; hard, fractured limestone bedrock.

The thickness of the solum, or the depth to limestone bedrock, ranges from 20 to 30 inches. The solum is neutral to medium acid.

The Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The A1 horizon is very dark gray (10YR 3/1) or very dark brown (10YR 2/2). It is 6 to 9 inches thick. Pedons in uncultivated areas have an A2 horizon, which is brown (10YR 4/3) or dark grayish brown (10YR 4/2). The B1 and B21t horizons are loam or clay loam in which the content of clay ranges from 20 to 28 percent. The B21t horizon has hue of 10YR, value of 4, and chroma of 3 or 4. The IIB22t horizon is clay loam, clay, or silty clay. It is no more than 6 inches thick. In some pedons it occurs only as thin rinds around flaggy limestone fragments.

Worthen series

The Worthen series consists of well drained, moderately permeable soils on alluvial fans and foot slopes. These soils formed in silty local alluvium. The native vegetation was grasses. Slope ranges from 2 to 5 percent.

Worthen soils are similar to Huntsville and Kennebec soils and commonly are adjacent to Arenzville, Otter, and Tama soils. The B horizon of Huntsville soils is less well expressed and less acid than that of the Worthen soils. Kennebec soils are somewhat poorly drained. Their B horizon is grayer than that of the Worthen soils. Arenzville soils formed in stratified sediments 20 to 40 inches deep over an older buried soil. Otter soils are poorly drained and do not have a B horizon. Their C horizon is grayer than that of the Worthen soils. Tama soils have a higher content of clay in the B horizon than the Worthen soils and a thinner A horizon. They are on upland ridges and side slopes above the Worthen soils. Arenzville, Huntsville, and Otter soils are in the lower lying areas on bottom land.

Typical pedon of Worthen silt loam, 2 to 5 percent slopes, 518 feet east and 300 feet south of the northwest corner of sec. 9, T. 92 N., R. 6 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
A12—8 to 14 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on faces of peds; weak fine granular structure; friable; slightly acid; gradual smooth boundary.
A13—14 to 25 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; slightly acid; clear smooth boundary.
A3—25 to 30 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.
B21—30 to 36 inches; brown (10YR 4/3) silt loam; dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.
B22—36 to 41 inches; yellowish brown (10YR 5/6) silt loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak medium prismatic structure parting to weak fine subangular blocky; friable; slightly acid; clear smooth boundary.
B3—41 to 54 inches; yellowish brown (10YR 5/6) silt loam; weak medium prismatic structure; friable; neutral; clear smooth boundary.
C—54 to 60 inches; yellowish brown (10YR 5/6) silt loam; few fine faint grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; massive; friable; few dark reddish concretions (manganese oxide); neutral.

The thickness of the solum ranges from 40 to 60 inches. The A horizon is 24 to 36 inches thick. It is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The B horizon is silt loam in which the content of clay ranges from 18 to 26 percent. In some pedons the lower part of the B3 horizon and the C horizon have a few faint mottles.

Zwingle series

The Zwingle series consists of poorly drained, very slowly permeable soils on stream benches or foot slopes below limestone bluffs (fig. 22). These soils formed in

Figure 22.—An area of Zwingle soils on a high stream terrace. Medary Variant soils are on the terrace escarpment, and Dorchester and Caneek soils are on the bottom land.

clayey and silty lacustrine sediments. The native vegetation was trees. Slope ranges from 0 to 9 percent.

Zwingle soils commonly are adjacent to Caneek, Dorchester, and Medary Variant soils. Caneek and Dorchester soils formed in silty alluvial material on bottom land. The moderately well drained Medary Variant soils are on escarpments on the stream benches. Their B horizon is less gray than that of the Zwingle soils.

Typical pedon of Zwingle silt loam, 0 to 2 percent slopes, in a pasture; 50 feet south and 1,248 feet west of the center of sec. 22, T. 94 N., R. 3 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure; friable; strongly acid; abrupt smooth boundary.

A2—6 to 10 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; weak thin platy and weak fine granular structure; friable; strongly acid; abrupt smooth boundary.

B21t—10 to 15 inches; dark brown (7.5YR 4/2) clay; common fine distinct brown (7.5YR 5/4) mottles; strong fine angular blocky structure; very firm; few dark concretions (manganese oxide); thick continuous dark brown (7.5YR 4/2) clay films; very strongly acid; gradual smooth boundary.

B22t—15 to 25 inches; dark brown (7.5YR 4/2) clay; common fine distinct light brown (7.5YR 6/4) and reddish yellow (7.5YR 6/6) mottles; strong fine angular blocky structure; very firm; few dark concretions (manganese oxide); thick continuous dark brown (7.5YR 4/2) clay films; strongly acid; clear smooth boundary.

B23t—25 to 32 inches; brown (7.5YR 5/2 and 5/4) clay; common fine distinct grayish brown (10YR 5/2) mottles; strong fine angular blocky structure; very firm; thick continuous brown (7.5YR 5/2) clay films; strongly acid; clear smooth boundary.

B24t—32 to 48 inches; dark reddish gray (5YR 4/2) clay; dark yellowish brown (10YR 4/4) streaks; strong fine angular blocky structure; very firm; medium acid; abrupt smooth boundary.

C1—48 to 56 inches; mottled yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) clay; massive; very firm; neutral; gradual smooth boundary.

C2—56 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; massive; firm; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 40 to 60 inches. The A1 horizon typically is silt loam but in some pedons is silty clay loam. It is 2 to 5 inches thick. It is very dark gray (10YR 3/1), dark grayish brown (10YR 4/2), or dark gray (10YR 4/1). The A2 horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 1 or 2. The B horizon has hue of 7.5YR, 2.5YR, 5YR, or 10YR, value of 3 to 6, and chroma of 2 to 6. It has mottles with chroma of 1 or 2. It is silty clay or clay in which the content of clay is as much as 60 percent. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4.

formation of the soils

The paragraphs that follow relate the factors of soil formation to the soils in Clayton County and describe the processes that result in the formation of soil horizons.

factors of soil formation

Soil forms through processes acting on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material (*5*). Human activities also affect soil formation.

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of parent material into a soil. A long period generally is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the others.

parent material

The accumulation of parent material is the first step in the formation of a soil. Some thin layers of several soils in the county formed as a result of the weathering of bedrock. Most of the soils, however, formed in material that was transported from the site of the parent rock and deposited at a new location through the action of glacial ice, water, wind, and gravity.

The principal parent materials in the county are loess, alluvium, residuum, glacial drift, and eolian sand. Much less extensive are lacustrine deposits and deposits of organic material.

Loess, a silty material deposited by wind, covers about 85 percent of the county. It ranges in depth from about 15 to 20 feet on the more stable ridges to a thin mantle of less than 4 to 10 feet on the side slopes. It overlies limestone bedrock and in some areas overlies both glacial till and limestone bedrock. The base of the Wisconsin-age loess in Iowa is 16,500 to 29,000 years old (*11*). Loess consists mostly of silt and some clay. It does not contain coarse sand or gravel, which were too large to be moved by the wind, but it does contain small amounts of fine sand and very fine sand, generally less than 5 percent.

Atterberry, Downs, Exette, Fayette, and Tama soils formed in a layer of loess more than 60 inches thick. Dubuque, Frankville, and Luana soils formed in a layer of loess less than 40 inches deep over limestone. Mottland and Nordness soils formed in a very thin layer of loess underlain by bedrock.

Alluvium is material that has been deposited by rivers and streams. Alluvial deposits of Late Wisconsin age are on the flood plains and terraces in the county. On about 4 percent of the acreage, the soils formed in this material. The major areas where the soils formed in alluvium are along the Turkey, Volga, and Mississippi Rivers and their tributaries. Large flood plains are along the Mississippi and Turkey Rivers, and a stream terrace of about 800 acres is in an area along the Volga River near the town of Volga.

Much of the alluvium in the county washed from loess-covered slopes in the uplands. The alluvial sediments commonly are silty and low in content of sand. Arenzville, Chaseburg, Huntsville, Kennebec, Ossian, and Otter soils formed in silty alluvium. Spillville and Terril soils formed in loamy alluvium. They contain more sand than the silty soils.

Textural differences among the alluvial soils are accompanied by some variations in the chemical and mineralogical composition of the soils. Some soils formed in recently deposited, calcareous alluvium. Examples are Caneek, Dorchester, and Volney soils. The other alluvial soils on flood plains are free carbonates and are neutral to medium acid.

Some alluvial material on foot slopes has been transported only a short distance. This local alluvium retains many characteristics of the soils on the slopes from which it has eroded. Worthen soils, which are on alluvial fans and foot slopes directly below loess-covered slopes, formed in this material.

The soils on terraces or second bottoms also formed in alluvium. They are above the flood plain and generally are not subject to flooding. Most are underlain by

coarser textured material within a depth of 4 to 6 feet. Their texture varies. Bertrand, Canoe, and Festina soils formed in silty alluvium, whereas Lawler, Saude, and Waukee soils formed in loamy alluvium overlying coarse sand and gravel.

Residuum is material weathered in place from sedimentary rocks. Limestone, sandstone, and shale are the types of sedimentary rocks in Clayton County (fig. 23). In most areas loess or glacial drift covers the residuum. The solum formed entirely in residuum in only a few areas. The solum in Goss soils formed almost entirely in residuum of limestone, and that in some areas of Calamine and Jacwin soils formed almost entirely in residuum of shale.

In Clayton County the layer of residuum generally is less than 6 inches deep over bedrock. A deposit of loess overlies a thin layer of residuum in Dubuque and Frankville soils. A layer of loamy material overlies a thin layer of limestone residuum in Rockton and Winneshiek soils. In some areas thin layers of glacial drift are directly above the residuum and are interbedded in the upper part of the residuum.

The residuum commonly is silty clay or clay. That weathered from limestone or sandstone commonly has a

Figure 23.—Outcrop of hard, fractured limestone bedrock. Bedrock crops out in many areas throughout the county.

reddish hue, whereas that weathered from shale is more yellowish.

Glacial drift is all rock material transported or deposited by glacial ice and all material of dominantly glacial origin deposited in the sea or in bodies of glacial melt water. It includes glacial till, which is unsorted sediment, the particles of which range in size from boulders to clay. The first of the glacial advances over Clayton County was the Nebraskan Glaciation, which occurred about 750,000 years ago (*6, 8, 12*). It was followed by the Kansan Glaciation, which began about 500,000 years ago. A third period of glaciation, called the Iowan Substage of the Wisconsin Glaciation, formerly was recognized (*8*), but it is now considered questionable. Intensive geomorphic and stratigraphic studies indicate that the landscape is a multilevel sequence of erosion surfaces and that many of the levels are cut into the Kansan and Nebraskan till (*14*).

Glacial drift is not extensive in Clayton County. In most areas the loess is underlain by scattered thin layers of drift at a depth of 6 to 15 feet. The drift is near the surface of Lindley soils, which formed in loam and clay loam glacial till. In the southwestern part of the county, a loamy mantle uniformly covers the drift. It generally is 1 or 2 feet thick, but in the lower, concave areas in the waterways, it is as much as 40 inches thick. A stone line or pebble band commonly separates the friable loamy mantle from the more dense, firm loam glacial till. In some areas the till has pockets of coarse textured material.

Bassett, Clyde, Floyd, Kenyon, and Oran soils formed in loamy material and in the underlying glacial till or till-derived sediments. Because they are in downslope areas and drainageways, Clyde and Floyd have a loamy mantle that is thicker than that of the other upland soils formed in glacial till. Rockton and Winneshiek soils formed in loamy till-derived sediments that are underlain by limestone bedrock at a depth of 2 to 3 feet.

Boulders 3 to 15 feet in diameter are on the surface of some areas mantled by glacial drift. Boulders and stones 6 to 30 inches in diameter are concentrated on the Clyde and Floyd soils in many of the upland drainageways.

Eolian sand is not extensive in Clayton County. It is deposited along the valleys of the major streams. These deposits are much higher in content of sand than the deposits of loess. Other areas of eolian sand occur as low mounds or dunes on the glacial till plains. In these areas the sand is underlain by till at various depths.

Wind-deposited sand is mainly fine and very fine quartz that is highly resistant to weathering. It has not been altered appreciably since it was deposited. Chelsea and Sparta soils formed mainly in wind-deposited loamy sand. Orwood soils formed in wind-deposited loamy material.

Lacustrine sediments are deposited in lake water. They are exposed when the water level in the lakes is lowered or the elevation of the land is raised. Not extensive in Clayton County, they are only on high benches along tributaries of the Mississippi River. Slack water material was deposited when the Mississippi River was blocked late in the glacial period. It extends to about 3 miles from the river along some of its tributaries.

The lacustrine deposits in the county are clayey. The content of clay ranges from 38 to 60 percent. The deposits are 2 to 5 feet deep over silty alluvial sediments. Medary Variant and Zwingle soils formed in these deposits.

Organic material is the parent material of muck and peat. Mucky soils are characterized by organic plant remains that are more thoroughly decomposed than those in peat. They are in small wet areas in the county where poor drainage has retarded the decay of plant remains. Palms muck is an example. The organic material in the county generally is about 18 to 50 inches thick, but a few deposits on small mounds are thicker.

climate

The soils in Clayton County probably formed under the influence of a midcontinental subhumid climate for at least 5,000 years. Between 5,000 and 16,000 years ago, the climate favored the growth of forest vegetation (*10, 19*). The morphology of most of the soils in the county indicates that the climate under which they formed is similar to the present one. The climate generally is uniform throughout the county but is marked by wide seasonal extremes in temperature. Precipitation is distributed throughout the year.

Climate is a major factor in determining what soils form in the various parent materials. It affects the rate and intensity of hydrolysis, carbonation, oxidation, and other important chemical reactions in the soil. Temperature, rainfall, relative humidity, and length of the frost-free period affect the kind of vegetation on the soil.

Local conditions somewhat modify the effect of the general climate of a region on soil formation. For example, the microclimate on south-facing slopes is warmer and less humid than that in nearby areas. Low lying, poorly drained areas are wetter and colder than most of the areas around them.

plant and animal life

Plant and animal life has an important effect on soil formation. Plant life is especially significant. It helps to initiate soil formation. As they grow and die, plants add organic matter to the upper layers of the soil. The native grasses, which have myriads of fibrous roots that extend to a depth of 10 to 20 inches, add large amounts of organic matter to the surface layer. Trees commonly feed on plant nutrients deep in the subsoil. As a result, they add little organic matter to the surface layer other than that added by fallen leaves and dead branches or trunks. Much of the organic matter from dead trees remains on the surface or is lost through decomposition.

Kenyon soils are typical of soils that formed under prairie grasses. Dubuque and Lindley are typical of soils that formed under trees. Atterberry and Oran soils have properties intermediate between those of soils that formed entirely under prairie grasses and those of soils that formed entirely under trees. Soils that formed under trees have a dark surface layer that generally is less than 5 inches thick. They have a lighter colored A2 horizon directly below the surface layer. In contrast, soils that formed under prairie grasses contain a large amount of organic matter derived from roots and have a thick dark surface layer.

Tama, Downs, and Fayette soils are members of a biosequence, or a group of soils that formed in the same parent material and under similar environmental conditions but supported different kinds of native vegetation. Tama soils formed under prairie grasses, Downs soils under mixed grasses and trees, and Fayette soils under trees. The main morphological differences among the three soils are the result of the different kinds of native vegetation.

The activities of burrowing animals and insects tend to loosen and aerate the upper few feet of the soil.

relief

Relief indirectly affects soil formation through its effect on drainage. In Clayton County it ranges from nearly level to very steep. Many nearly level soils are frequently flooded and have a seasonal high water table. Water soaks into nearly level soils that are not flooded. Much of the rainfall runs off the surface of the more sloping soils, and less penetrates the surface. The steeper Nordness soils are an example. They show very little evidence of soil formation.

The color of the subsoil is affected by natural drainage. It is dominantly olive gray, for example, in the poorly drained Ossian soils, which have a seasonal high water table at a depth of 1 to 2 feet. It is dominantly yellowish brown in the well drained Bertrand, Downs, Fayette, Festina, and Tama soils, which have a seasonal high water table below a depth of 6 feet. The subsoil tends to be grayish brown and mottled in the somewhat poorly drained Atterberry, Canoe, Floyd, Lawler, and Oran soils. Of the soils that formed under prairie grasses, those that have a seasonal high water table generally contain more organic matter in the surface layer than those that are well drained.

Some of the properties of Downs, Exette, Fayette, and other soils that have a wide slope range vary according to the slope. Two of these are the depth to carbonates and the thickness of the surface layer. Carbonates are closer to the surface in areas where slopes are steepest. Also, the surface layer is thinner. Other properties that vary according to the slope are the maximum percent of clay in the B horizon and the depth to the layer that has the highest content of clay (*7*). Both of these decrease with increasing slope (*4, 7*).

Aspect and topographic position, as well as gradient, have a significant effect on soil formation. South-facing slopes, for example, generally are warmer and drier than north-facing slopes and consequently support a different kind and amount of vegetation. The nearly level Richwood, Rowley, and Ossian soils formed in the same kind of parent material and under similar vegetation but differ because of slight differences in topographic position. Their microrelief affects runoff and the depth to the seasonal high water table. The poorly drained Ossian soils are at low elevations on stream benches. They have a seasonal high water table and impound water for short periods. The somewhat poorly drained Rowley soils are at the slightly higher elevations on the benches and the well drained Richwood soils at the higher elevations. Terril and Worthen soils are on foot slopes and in upland waterways. They have properties related to the upslope soils from which they receive sediments.

The influence of porous, rapidly permeable parent material may override the influence of topography. Even though they are no more than gently sloping, Flagler soils, for example, are somewhat excessively drained because they have a moderately rapidly permeable subsoil and a very rapidly permeable substratum.

time

Time is needed for the various processes of soil formation to take effect. The amount of time needed ranges from a few years for the formation of a thin A horizon in fresh alluvial deposits, such as the A horizon in Caneek silt loam, channeled, to a thousand years or more for the formation of a subsoil in many of the older upland soils. The older soils have well defined genetic horizons. Downs and Fayette soils are examples. The younger soils have only weakly expressed horizons. Some of the soils that formed in alluvium, for example, show little or no evidence of profile development because fresh material is deposited periodically. The material has not been in place long enough for the climate and vegetation to form well defined genetic horizons.

If other factors are favorable, the texture of the subsoil generally becomes finer and a greater amount of soluble material is leached out as the soils continue to weather. Exceptions are soils that formed in quartz sand, such as Sparta soils, or in other material that is resistant to weathering. These soils do not change much over a long period. Other exceptions are the steep Nordness soils. These soils form more slowly than the less sloping soils in stable areas because only a small amount of water penetrates the surface and a large amount runs off.

In areas where ice, water, or wind has buried organic material under soil material, the age of a landscape can be determined through radiocarbon dating (*13*). Radiocarbon dates indicate that the loess in which Downs, Fayette, and Tama soils formed is probably about 14,000 to 20,000 years old. The Iowan erosion

surface formed during the period when this loess was deposited. In areas where it is covered by loamy sediments, this surface is less than 14,000 years old (*11*) and the soils on the ridges and side slopes, such as Bassett, Kenyon, and Oran soils, are probably much younger. Clyde and Floyd soils, which are in drainageways and other areas lower on the landscape, are younger than the Bassett, Kenyon, and Oran soils.

human activities

Important changes took place when Clayton County was settled. Some had little effect on soil productivity; others had drastic effects.

Breaking the prairie sod and clearing the timber removed and changed the protective plant cover. Cultivation increases the susceptibility of the more sloping soils to erosion, which removes topsoil, organic matter, and plant nutrients. Sheet erosion, which is the most prevalent kind of erosion in the county, removes a few inches of topsoil at one time. Cultivation generally destroys all evidence of this loss. In some areas, shallow and deep gullies have formed and the eroded soil material has been deposited on the lower slopes. As the land was brought under cultivation, the runoff rate increased and the rate at which water moved into the soil decreased. As a result, accelerated erosion removed part or all of the original surface layer from many of the more sloping soils.

Cultivation and erosion changed the structure and consistence of the surface layer of some soils and the content of organic matter and level of fertility. In severely eroded areas the plow layer commonly includes the upper part of the subsoil, which is less friable and finer textured than the surface layer. Even in areas that are not subject to erosion, compaction by heavy machinery reduces the thickness of the surface layer and changes the structure. The granular structure characteristic of native grassland breaks down when the soils are intensively cropped. The surface layer generally is hard when dry. The fine textured soils that have been plowed many times during wet periods tend to puddle and are more slowly permeable than similar soils in uncultivated areas.

Eroded soil material from hillsides commonly is deposited in the lower lying areas. For example, Arenzville, Caneek, and Dorchester soils, which formed in recent alluvium, have strata of light and dark colored soil material washed from the hillsides and deposited by floodwater.

Some management measures decrease the susceptibility to erosion, increase soil productivity, and reclaim areas not suitable for crops or pasture. For example, large areas on bottom land are suitable for cultivation because flooding and deposition are controlled by diversions at the base of slopes, by drainage ditches, and by other measures. Many soils are more productive than they were naturally because applications of commercial fertilizer and lime have overcome deficiencies in plant nutrients. In some areas erosion and runoff are controlled by terraces and other measures.

Erosion is the main cause of a decrease in the content of organic matter in soils (*16*). Though they cannot increase the content to the level that was characteristic of native grassland, measures that control erosion can keep the content at a level that is needed when crops are grown.

processes of soil formation

Horizon differentiation is the result of four basic processes. These are additions, removals, transfers, and transformations (*15*). Each of these affects many substances in the soils, such as organic matter, soluble salts, carbonates, sesquioxides, and silicate clay minerals. The changes brought about by these processes help to determine the ultimate nature of the soil profile.

The accumulation of organic matter is an early phase in formation of most soils. The content of organic matter ranges from very high to very low in the A1 horizon of the soils in Clayton County. It is low in the thin A1 horizon of Fayette soils and high in the thick A1 horizon of Colo soils. In some soils it is low because erosion has removed part of the A horizon.

The removal of substances from parts of the profile has differentiated horizons in most of the soils in the county. The downward movement of calcium carbonate and bases is an example. Free carbonates have been leached from the upper part of nearly all of the soils. Exceptions are Caneek and Dorchester soils. Some soils are so strongly leached that they are strongly acid or very strongly acid in the subsoil.

A number of substances are transferred from one horizon to another in the soils of the county. Phosphorus, for example, is removed from the subsoil by plant roots and transferred to the parts of the plant growing above the ground. It is then added to the surface layer in the plant residue. This process affects the form and distribution of the phosphorus in the profile.

The translocation of silicate clay minerals has an important effect on horizon differentiation. The clay minerals are carried downward in suspension by percolating water from the A horizon. They accumulate in the B horizon as fillings in pores and root channels and as clay films on the faces of peds. This process has affected many of the soils in the county. In other soils, the clay content of the A horizon is not markedly different from that of the B horizon and other evidence of clay movement is minimal.

Another kind of transfer occurs only in the very clayey soils. Cracks form when these soils shrink and swell. As a result, some of the material from the surface layer is

transferred to the lower parts of the profile. This kind of transfer can occur in Medary Variant and Zwingle soils.

Transformations are physical and chemical. The weathering of soil particles to smaller sizes is an example of transformation. The reduction of iron is another example. This process is called gleying. It occurs when the soil is saturated for long periods. It is evidenced by ferrous iron and gray colors in the soil. It is a characteristic of poorly drained soils, such as Ossian soils. Reductive extractable iron, or free iron, generally is not so evident in somewhat poorly drained soils, such as Rowley soils.

Another kind of transformation is the weathering of the primary apatite mineral in the parent material to secondary phosphorus compounds. This process occurs in Colo and other soils that have a pH near 7. The supply of available phosphorus is higher in these soils than in Dorchester and other soils that have a pH of more than 7.

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glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and leaves all or part of the crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdivisions of this horizon (A1, A2, and A3).

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-77 at Guttenberg, Iowa]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	27.1	8.4	17.8	50	-23	0	.80	.36	1.15	3	7.0
February---	33.0	13.9	23.4	56	-18	0	1.04	.29	1.64	3	6.1
March------	42.8	24.4	33.6	73	-5	21	2.08	1.05	2.91	6	4.7
April------	59.0	38.4	48.7	85	19	96	3.36	2.05	4.53	7	1.2
May--------	71.3	50.1	60.7	91	31	345	3.80	2.18	5.12	8	.0
June-------	80.0	59.6	69.8	94	44	594	4.22	2.34	5.76	8	.0
July-------	84.0	63.8	73.9	97	49	741	4.77	2.82	6.50	7	.0
August-----	82.1	61.9	72.0	95	47	682	3.46	1.52	5.03	6	.0
September--	73.7	52.5	63.1	91	34	393	2.95	1.15	4.40	6	.0
October----	63.4	42.5	53.0	86	23	183	2.23	.82	3.37	5	.0
November---	45.7	28.7	37.3	69	4	10	1.66	.55	2.54	4	1.3
December---	32.1	16.1	24.1	59	-17	0	1.31	.67	1.83	4	7.8
Yearly:											
Average--	57.9	38.4	48.1	---	---	---	---	---	---	---	---
Extreme--	---	---	---	97	-24	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,065	31.68	26.30	36.82	67	28.1

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-77 at Guttenberg, Iowa]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 13	April 23	May 8
2 years in 10 later than--	April 9	April 19	May 3
5 years in 10 later than--	April 2	April 12	April 25
First freezing temperature in fall:			
1 year in 10 earlier than--	October 21	October 10	September 25
2 years in 10 earlier than--	October 26	October 15	October 1
5 years in 10 earlier than--	November 4	October 25	October 12

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-77 at Guttenberg, Iowa]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	198	176	149
8 years in 10	204	183	156
5 years in 10	215	195	169
2 years in 10	226	208	182
1 year in 10	232	215	189

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
40	Fayette silt loam, karst, 9 to 25 percent slopes	120	*
41B	Sparta loamy fine sand, 2 to 5 percent slopes	820	0.2
41C	Sparta loamy fine sand, 5 to 12 percent slopes	530	0.1
63B	Chelsea loamy fine sand, 2 to 5 percent slopes	925	0.2
63C	Chelsea loamy fine sand, 5 to 14 percent slopes	1,915	0.4
63E	Chelsea loamy fine sand, 14 to 25 percent slopes	1,020	0.2
65D2	Lindley loam, 9 to 14 percent slopes, moderately eroded	630	0.1
65F2	Lindley loam, 14 to 25 percent slopes, moderately eroded	1,900	0.4
65F3	Lindley loam, 14 to 25 percent slopes, severely eroded	750	0.2
83B	Kenyon loam, 2 to 5 percent slopes	5,800	1.2
84	Clyde clay loam, 1 to 3 percent slopes	830	0.2
98	Huntsville silt loam, 0 to 2 percent slopes	3,200	0.6
109B	Backbone fine sandy loam, 2 to 5 percent slopes	1,025	0.2
109C	Backbone fine sandy loam, 5 to 9 percent slopes	855	0.2
109D	Backbone fine sandy loam, 9 to 14 percent slopes	540	0.1
110	Lamont fine sandy loam, 0 to 2 percent slopes	435	0.1
110B	Lamont fine sandy loam, 2 to 5 percent slopes	490	0.1
110C	Lamont fine sandy loam, 5 to 9 percent slopes	535	0.1
120B	Tama silt loam, 2 to 5 percent slopes	3,150	0.6
120C	Tama silt loam, 5 to 9 percent slopes	430	0.1
129B	Arenzville-Chaseburg silt loams, 1 to 5 percent slopes	6,800	1.4
133	Colo silty clay loam, 0 to 2 percent slopes	600	0.1
136	Ankeny fine sandy loam, 0 to 2 percent slopes	640	0.1
142	Chaseburg silt loam, 0 to 2 percent slopes	800	0.2
158	Dorchester silt loam, 0 to 2 percent slopes	5,275	1.1
162B	Downs silt loam, 2 to 5 percent slopes	7,200	1.4
162C	Downs silt loam, 5 to 9 percent slopes	15,600	3.1
162C2	Downs silt loam, 5 to 9 percent slopes, moderately eroded	18,500	3.7
162D	Downs silt loam, 9 to 14 percent slopes	920	0.2
162D2	Downs silt loam, 9 to 14 percent slopes, moderately eroded	24,600	4.9
162E2	Downs silt loam, 14 to 18 percent slopes, moderately eroded	730	0.1
163B	Fayette silt loam, 2 to 5 percent slopes	5,600	1.1
163C	Fayette silt loam, 5 to 9 percent slopes	12,200	2.4
163C2	Fayette silt loam, 5 to 9 percent slopes, moderately eroded	25,500	5.1
163D	Fayette silt loam, 9 to 14 percent slopes	6,150	1.2
163D2	Fayette silt loam, 9 to 14 percent slopes, moderately eroded	71,395	14.3
163D3	Fayette silty clay loam, 9 to 14 percent slopes, severely eroded	1,250	0.3
163E	Fayette silt loam, 14 to 18 percent slopes	9,400	1.9
163E2	Fayette silt loam, 14 to 18 percent slopes, moderately eroded	34,900	7.0
163E3	Fayette silty clay loam, 14 to 18 percent slopes, severely eroded	5,300	1.1
163F	Fayette silt loam, 18 to 25 percent slopes	6,100	1.2
163F2	Fayette silt loam, 18 to 25 percent slopes, moderately eroded	6,890	1.4
163F3	Fayette silty clay loam, 18 to 25 percent slopes, severely eroded	1,960	0.4
163G	Fayette silt loam, 25 to 40 percent slopes	4,800	1.0
171B	Bassett loam, 2 to 5 percent slopes	1,440	0.3
171C2	Bassett loam, 5 to 9 percent slopes, moderately eroded	480	0.1
177	Saude loam, 0 to 2 percent slopes	645	0.1
177B	Saude loam, 2 to 5 percent slopes	350	0.1
178	Waukee loam, 0 to 2 percent slopes	520	0.1
183C	Dubuque silt loam, 20 to 30 inches to limestone, 5 to 9 percent slopes	650	0.1
183D	Dubuque silt loam, 20 to 30 inches to limestone, 9 to 14 percent slopes	940	0.2
183D2	Dubuque silt loam, 20 to 30 inches to limestone, 9 to 14 percent slopes, moderately eroded	2,130	0.4
183E	Dubuque silt loam, 20 to 30 inches to limestone, 14 to 18 percent slopes	4,760	1.0
183E2	Dubuque silt loam, 20 to 30 inches to limestone, 14 to 18 percent slopes, moderately eroded	12,200	2.4
183E3	Dubuque silty clay loam, 20 to 30 inches to limestone, 14 to 18 percent slopes, severely eroded	840	0.2
183F	Dubuque silt loam, 20 to 30 inches to limestone, 18 to 25 percent slopes	3,230	0.6
196C	Volney channery silt loam, 5 to 12 percent slopes	690	0.1
213B	Rockton loam, 30 to 40 inches to limestone, 2 to 5 percent slopes	800	0.2
214B	Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes	650	0.1
215E	Goss loam, 9 to 18 percent slopes	770	0.2
221B	Palms muck, 1 to 4 percent slopes	270	0.1
225	Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	420	0.1
226	Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes	380	0.1
249	Zwingle silt loam, 0 to 2 percent slopes	470	0.1
249C	Zwingle silt loam, 2 to 9 percent slopes	380	0.1
284	Flagler sandy loam, 0 to 2 percent slopes	730	0.1
284B	Flagler sandy loam, 2 to 5 percent slopes	430	0.1
291	Atterberry silt loam, 1 to 3 percent slopes	635	0.1
320	Arenzville silt loam, 0 to 2 percent slopes	4,100	0.8

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
323B	Terril loam, sandy substratum, 2 to 5 percent slopes	970	0.2
391B	Clyde-Floyd complex, 1 to 4 percent slopes	4,800	1.0
408B	Olin fine sandy loam, 2 to 5 percent slopes	2,600	0.5
408C	Olin fine sandy loam, 5 to 9 percent slopes	450	0.1
444B	Jacwin loam, 2 to 5 percent slopes	1,000	0.2
444C	Jacwin loam, 5 to 9 percent slopes	635	0.1
444D	Jacwin loam, 9 to 14 percent slopes	430	0.1
462B	Downs silt loam, benches, 2 to 5 percent slopes	540	0.1
463B	Fayette silt loam, benches, 2 to 5 percent slopes	700	0.1
463C	Fayette silt loam, benches, 5 to 9 percent slopes	605	0.1
471	Oran loam, 0 to 2 percent slopes	470	0.1
478G	Rock outcrop-Nordness complex, 25 to 60 percent slopes	30,200	6.1
480B	Orwood silt loam, 2 to 5 percent slopes	435	0.1
480C	Orwood silt loam, 5 to 9 percent slopes	610	0.1
480D2	Orwood silt loam, 9 to 14 percent slopes, moderately eroded	565	0.1
480E2	Orwood silt loam, 14 to 18 percent slopes, moderately eroded	460	0.1
483C	Frankville silt loam, 20 to 30 inches to limestone, 5 to 9 percent slopes	520	0.1
483D2	Frankville silt loam, 20 to 30 inches to limestone, 9 to 14 percent slopes, moderately eroded	780	0.2
483E2	Frankville silt loam, 20 to 30 inches to limestone, 14 to 18 percent slopes, moderately eroded	1,135	0.3
485	Spillville loam, 0 to 2 percent slopes	950	0.2
487B	Otter-Worthen silt loams, 1 to 4 percent slopes	8,820	1.8
489	Ossian silt loam, 0 to 2 percent slopes	1,100	0.2
490	Caneek silt loam, 0 to 2 percent slopes	1,295	0.3
496B	Dorchester-Volney complex, 1 to 5 percent slopes	5,480	1.1
497E	Fayette-Dubuque silt loams, 14 to 18 percent slopes	2,780	0.6
497F	Fayette-Dubuque silt loams, 18 to 30 percent slopes	13,180	2.6
499B	Nordness silt loam, 2 to 5 percent slopes	700	0.1
499D	Nordness silt loam, 5 to 14 percent slopes	2,600	0.5
499F	Nordness silt loam, 14 to 25 percent slopes	21,660	4.3
512B	Marlean loam, 2 to 5 percent slopes	490	0.1
512D2	Marlean loam, 5 to 14 percent slopes, moderately eroded	710	0.1
551	Calamine loam, 1 to 3 percent slopes	520	0.1
589	Otter silt loam, 0 to 2 percent slopes	1,350	0.3
589+	Otter silt loam, overwash, 0 to 2 percent slopes	1,050	0.2
612D2	Mottland silt loam, 5 to 14 percent slopes, moderately eroded	960	0.2
612E2	Mottland silt loam, 14 to 18 percent slopes, moderately eroded	2,190	0.4
714B	Winneshiek loam, 20 to 30 inches to limestone, 2 to 5 percent slopes	980	0.2
714C	Winneshiek loam, 20 to 30 inches to limestone, 5 to 9 percent slopes	600	0.1
763D2	Exette silt loam, 9 to 14 percent slopes, moderately eroded	1,200	0.2
763D3	Exette silt loam, 9 to 14 percent slopes, severely eroded	890	0.2
763E2	Exette silt loam, 14 to 18 percent slopes, moderately eroded	2,930	0.6
763E3	Exette silt loam, 14 to 18 percent slopes, severely eroded	1,255	0.3
763F2	Exette silt loam, 18 to 25 percent slopes, moderately eroded	5,120	1.0
763F3	Exette silt loam, 18 to 25 percent slopes, severely eroded	1,300	0.3
776B	Lilah sandy loam, 2 to 5 percent slopes	670	0.1
776C	Lilah sandy loam, 5 to 9 percent slopes	540	0.1
777	Wapsie loam, 0 to 2 percent slopes	710	0.1
777B	Wapsie loam, 2 to 5 percent slopes	550	0.1
793	Bertrand silt loam, 0 to 2 percent slopes	1,830	0.4
826	Rowley silt loam, 0 to 2 percent slopes	730	0.1
863B	Fayette silt loam, karst, 2 to 5 percent slopes	310	0.1
863D	Fayette silt loam, karst, 5 to 14 percent slopes	870	0.2
902C	Luana silt loam, 5 to 9 percent slopes	1,020	0.2
902D2	Luana silt loam, 9 to 14 percent slopes, moderately eroded	2,840	0.6
926	Canoe silt loam, 0 to 2 percent slopes	725	0.1
930	Orion silt loam, 0 to 2 percent slopes	740	0.2
930B	Orion silt loam, 2 to 5 percent slopes	2,490	0.5
951F	Medary Variant silt loam, 18 to 30 percent slopes	415	0.1
977	Richwood silt loam, 0 to 2 percent slopes	890	0.2
978	Festina silt loam, 0 to 2 percent slopes	980	0.2
981B	Worthen silt loam, 2 to 5 percent slopes	2,612	0.5
1158	Dorchester silt loam, channeled, 0 to 2 percent slopes	1,435	0.3
1212	Kennebec silt loam, 0 to 2 percent slopes	1,480	0.3

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1219	Canoe Variant silt loam, 0 to 2 percent slopes	610	0.1
1490	Caneek silt loam, channeled, 0 to 2 percent slopes	9,400	1.9
5010	Pits, sand and gravel	80	*
5030	Pits, limestone quarries	190	*
5040	Orthents, loamy	90	*
	Water	610	0.1
	Total	498,752	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
40**. Fayette							
41B. Sparta	61	23	45	2.5	2.0	3.5	3.8
41C. Sparta	---	---	38	1.8	2.0	2.7	2.9
63B. Chelsea	57	21	42	2.0	2.0	3.3	3.3
63C. Chelsea	---	---	35	1.5	1.5	2.5	2.5
63E. Chelsea	---	---	---	1.0	1.0	1.6	1.6
65D2. Lindley	65	24	36	2.9	2.3	3.6	4.0
65F2. Lindley	---	---	---	1.0	1.0	1.6	1.6
65F3. Lindley	---	---	---	---	.8	1.4	1.4
83B. Kenyon	113	43	90	4.7	4.2	6.6	7.8
84. Clyde	102	39	82	4.0	6.6	5.5	6.6
98. Huntsville	125	48	93	5.2	4.1	7.5	8.6
109B. Backbone	65	25	45	2.7	2.3	3.8	4.5
109C. Backbone	50	19	35	2.1	2.0	3.0	3.5
109D. Backbone	---	---	---	1.8	1.6	2.2	3.0
110. Lamont	71	27	53	2.5	2.4	3.6	4.1
110B. Lamont	69	26	52	2.5	2.3	3.5	4.1
110C. Lamont	64	24	48	2.3	2.1	3.3	3.8
120B. Tama	125	48	95	5.2	4.2	7.5	8.6
120C. Tama	120	46	90	5.0	4.0	7.1	8.3
129B. Arenzville-Chaseburg	95	36	76	4.0	3.6	5.5	6.6

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
133------------------------ Colo	104	40	78	4.2	4.2	5.5	7.0
136------------------------ Ankeny	80	30	60	3.5	3.0	4.3	5.0
142------------------------ Chaseburg	108	40	86	4.5	4.0	6.1	7.5
158------------------------ Dorchester	104	40	83	4.4	4.0	6.1	7.3
162B----------------------- Downs	119	45	95	5.0	4.1	7.1	8.3
162C----------------------- Downs	114	43	91	4.8	4.0	6.8	8.1
162C2---------------------- Downs	111	42	89	4.7	3.8	6.6	7.8
162D----------------------- Downs	105	40	84	4.4	3.8	6.3	7.3
162D2---------------------- Downs	102	39	82	4.3	3.6	6.1	7.1
162E2---------------------- Downs	87	33	69	3.7	3.5	5.1	6.1
163B----------------------- Fayette	113	43	90	4.7	4.0	6.6	7.8
163C----------------------- Fayette	108	41	86	4.5	3.8	6.5	7.5
163C2---------------------- Fayette	105	40	84	4.4	3.6	6.5	7.5
163D----------------------- Fayette	99	38	80	4.2	3.6	6.0	7.0
163D2---------------------- Fayette	96	36	76	4.0	3.5	5.8	6.6
163D3---------------------- Fayette	90	34	72	3.8	3.5	5.3	6.3
163E----------------------- Fayette	84	32	67	3.5	3.3	5.0	5.8
163E2---------------------- Fayette	81	31	65	3.4	3.2	4.8	5.6
163E3---------------------- Fayette	---	---	62	3.2	3.0	4.5	5.3
163F----------------------- Fayette	---	---	60	3.4	3.1	4.8	5.6
163F2---------------------- Fayette	---	---	55	3.2	2.8	4.5	5.0
163F3---------------------- Fayette	---	---	---	3.0	2.5	4.2	4.6

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
163G------ Fayette	---	---	---	3.0	3.0	4.2	5.0
171B------ Bassett	107	40	85	4.5	4.0	6.5	7.5
171C2------ Bassett	99	38	80	4.0	3.5	6.0	6.6
177------ Saude	78	30	62	3.3	3.0	4.6	5.5
177B------ Saude	76	29	61	3.2	3.0	4.5	5.3
178------ Waukee	98	37	78	4.1	4.0	5.8	6.8
183C------ Dubuque	68	26	54	2.8	2.4	4.0	4.6
183D------ Dubuque	59	25	47	2.5	2.0	3.5	4.1
183D2------ Dubuque	56	21	45	2.3	1.8	3.3	3.8
183E------ Dubuque	---	---	40	2.1	1.6	3.0	3.5
183E2------ Dubuque	---	---	38	1.9	1.4	2.8	3.1
183E3------ Dubuque	---	---	---	1.8	1.2	2.4	3.0
183F------ Dubuque	---	---	---	1.8	1.2	2.2	3.0
196C------ Volney	---	---	---	3.0	2.0	4.1	5.0
213B------ Rockton	96	36	77	4.0	3.6	5.8	6.6
214B------ Rockton	76	29	60	3.0	2.6	3.8	5.0
215E------ Goss	---	---	20	1.2	1.3	1.8	2.0
221B------ Palms	75	29	61	3.0	3.1	3.6	5.0
225------ Lawler	85	32	68	3.6	3.7	5.0	6.0
226------ Lawler	100	38	80	4.2	4.0	6.0	7.0
249------ Zwingle	62	24	46	2.5	2.5	3.6	4.1
249C------ Zwingle	53	20	40	2.2	2.3	3.1	3.6
284------ Flagler	72	27	58	3.0	2.3	4.3	5.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
284B Flagler	70	26	56	2.9	2.1	4.1	4.8
291 Atterberry	125	47	93	5.0	4.0	7.0	8.3
320 Arenzville	106	40	85	4.5	4.0	6.6	7.5
323B Terril	118	45	94	5.0	4.2	7.0	8.3
391B Clyde-Floyd	103	39	83	4.2	5.6	6.0	7.0
408B Olin	97	37	73	4.1	3.0	5.8	6.8
408C Olin	92	35	70	3.9	2.8	5.5	6.5
444B Jacwin	85	32	68	3.4	3.0	5.0	5.6
444C Jacwin	70	30	56	2.8	2.6	4.1	4.6
444D Jacwin	50	20	40	2.0	2.3	3.0	3.3
462B Downs	119	45	95	5.0	4.1	7.1	8.3
463B Fayette	113	43	90	4.7	4.0	6.6	7.8
463C Fayette	108	41	86	4.5	3.8	6.5	7.5
471 Oran	109	41	87	4.6	4.0	6.5	7.6
478G**. Rock outcrop-Nordness							
480B Orwood	105	40	84	4.4	3.8	6.3	7.3
480C Orwood	100	38	80	4.2	3.7	6.0	7.0
480D2 Orwood	86	33	69	3.6	3.4	5.1	6.0
480E2 Orwood	70	27	57	2.9	3.2	4.1	4.8
483C Frankville	74	28	59	3.1	2.8	4.3	5.1
483D2 Frankville	69	26	55	2.9	2.5	4.1	4.8
483E2 Frankville	---	---	47	2.6	2.3	3.6	4.3
485 Spillville	122	46	98	5.1	4.2	7.3	8.6

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
487B: Otter-Worthen	102	39	75	4.0	2.1	5.5	6.6
489: Ossian	110	42	88	4.6	4.1	6.5	7.6
490: Caneek	104	40	83	4.3	3.8	6.0	7.1
496B: Dorchester-Volney	---	---	---	3.0	1.6	4.2	5.0
497E: Fayette-Dubuque	---	---	---	2.4	1.8	3.2	3.8
497F: Fayette-Dubuque	---	---	---	2.1	1.6	3.0	3.5
499B: Nordness	35	12	29	1.5	1.5	2.0	2.5
499D: Nordness	---	---	20	1.2	1.0	1.2	2.0
499F: Nordness	---	---	---	0.5	0.7	0.8	0.8
512B: Marlean	58	22	46	2.4	2.3	3.5	4.0
512D2: Marlean	---	---	34	1.9	1.5	2.4	3.1
551: Calamine	75	29	60	3.0	2.6	4.0	5.0
589: Otter	110	42	88	4.7	4.1	6.6	7.6
589+: Otter	106	40	84	4.5	4.0	6.0	7.3
612D2: Mottland	65	24	51	2.8	2.1	3.2	4.4
612E2: Mottland	50	19	40	2.1	1.6	3.0	3.5
714B: Winneshiek	70	27	56	2.9	2.6	4.1	4.8
714C: Winneshiek	65	25	52	2.7	2.5	3.8	4.5
763D2: Exette	92	35	73	3.9	3.5	5.5	6.5
763D3: Exette	95	36	76	4.0	3.6	5.7	6.6
763E2: Exette	75	---	60	3.2	2.5	4.5	5.3
763E3: Exette	---	---	---	3.0	2.2	2.5	5.0
763F2: Exette	---	---	50	2.8	2.0	2.9	4.6

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
763F3 Exette	---	---	---	2.6	1.8	2.0	4.4
776B Lilah	43	16	34	1.5	1.1	1.4	2.5
776C Lilah	38	15	30	1.3	1.0	1.2	2.1
777 Wapsie	72	27	57	3.0	2.7	4.3	5.0
777B Wapsie	70	27	56	2.9	2.6	4.1	4.8
793 Bertrand	110	42	88	4.6	4.0	6.6	7.6
826 Rowley	126	48	100	5.5	4.6	7.3	8.8
863B Fayette	61	22	38	2.3	2.1	3.6	4.4
863D Fayette	---	---	---	0.5	0.7	0.8	0.8
902C Luana	104	40	86	4.6	2.8	6.4	7.9
902D2 Luana	75	32	70	3.9	2.5	5.9	6.3
926 Canoe	120	46	96	5.0	4.2	7.1	8.3
930 Orion	102	35	82	4.2	3.6	6.2	7.1
930B Orion	90	26	76	3.9	3.3	5.6	6.6
951F Medary Variant	---	---	---	1.2	1.2	2.0	2.2
977 Richwood	122	46	98	5.1	4.1	7.3	8.5
978 Festina	116	44	93	4.9	4.0	6.9	8.1
981B Worthen	120	46	95	5.2	4.0	7.3	8.4
1158 Dorchester	---	---	---	---	3.0	---	---
1212 Kennebec	121	46	80	5.1	4.2	7.1	8.5
1219 Canoe Variant	102	42	80	4.6	4.0	6.8	8.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
1490------------------------ Caneek	---	---	---	---	3.5	---	---
5010**, 5030**. Pits							
5040**. Orthents							

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	10,290	---	---	---
II	81,472	42,177	35,980	3,315
III	186,370	184,465	740	1,165
IV	68,565	61,770	---	6,795
V	10,835	---	10,835	---
VI	63,165	50,700	---	12,465
VII	77,085	24,205	---	52,880
VIII	---	---	---	---

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
40----------------- Fayette	2r	Moderate	Moderate	Slight	Slight	White oak----------- Northern red oak----	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
41B, 41C----------- Sparta	3s	Slight	Slight	Severe	Slight	Jack pine----------- Northern red oak---- Red pine------------	57 47 ---	Red pine, eastern white pine, jack pine.
63B, 63C----------- Chelsea	3s	Slight	Slight	Moderate	Slight	White oak-----------	55	Eastern white pine, Scotch pine, European larch, eastern redcedar, red pine, jack pine.
63E---------------- Chelsea	3s	Moderate	Severe	Moderate	Slight	White oak-----------	55	Eastern white pine, Scotch pine, European larch, eastern redcedar, red pine, jack pine.
65D2--------------- Lindley	5o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak----	50 ---	White oak, green ash, yellow-poplar, northern red oak.
65F2, 65F3--------- Lindley	5r	Moderate	Moderate	Moderate	Slight	White oak----------- Northern red oak----	50 ---	White oak, green ash, yellow-poplar, northern red oak.
98----------------- Huntsville	1o	Slight	Slight	Slight	Slight	Eastern cottonwood-- Yellow-poplar------- Green ash-----------	110 98 ---	Eastern cottonwood, black walnut, red maple, sugar maple, green ash, common hackberry.
109B, 109C, 109D--- Backbone	3o	Slight	Slight	Slight	Slight	Northern red oak---- White oak-----------	55 55	Eastern white pine, red pine, black walnut, sugar maple.
110, 110B, 110C---- Lamont	3o	Slight	Slight	Slight	Slight	Northern red oak---- White oak-----------	55 55	Eastern white pine, eastern redcedar.
129B*:								
Arenzville--------	2o	Slight	Slight	Slight	Slight	Northern red oak---- Bur oak------------- Silver maple--------	65 --- ---	Red pine, eastern white pine, white spruce, northern red oak, black walnut.
Chaseburg---------	2o	Slight	Slight	Slight	Slight	Northern red oak---- Sugar maple--------- American basswood---	65 --- ---	Red pine, eastern white pine, white spruce, sugar maple, black walnut, northern red oak.
142---------------- Chaseburg	2o	Slight	Slight	Slight	Slight	Northern red oak---- Sugar maple--------- American basswood---	65 --- ---	Red pine, eastern white pine, white spruce, sugar maple, black walnut, northern red oak.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
158----------------- Dorchester	3o	Slight	Slight	Moderate	Slight	White oak----------- Northern red oak----	55 55	Ponderosa pine, Austrian pine, Scotch pine, common hackberry, green ash, poplar.
162B, 162C, 162C2, 162D, 162D2------- Downs	2o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak----	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
162E2-------------- Downs	2r	Moderate	Moderate	Slight	Slight	White oak----------- Northern red oak----	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
163B, 163C, 163C2, 163D, 163D2, 163D3------------- Fayette	2o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak----	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G------- Fayette	2r	Moderate	Moderate	Slight	Slight	White oak----------- Northern red oak----	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
171B, 171C2-------- Bassett	3o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak----	55 55	Eastern white pine, red pine, black walnut, sugar maple.
183C, 183D, 183D2-- Dubuque	2o	Slight	Slight	Slight	Slight	Northern red oak---- White oak-----------	65 65	Eastern white pine, red pine, eastern redcedar, Norway spruce, European larch, black walnut.
183E, 183E2, 183E3, 183F-------------- Dubuque	2r	Moderate	Moderate	Slight	Slight	Northern red oak---- White oak-----------	65 65	Eastern white pine, red pine, eastern redcedar, Norway spruce, European larch, black walnut.
196C--------------- Volney	3o	Slight	Slight	Slight	Slight	Northern red oak---- White oak-----------	55 55	Eastern white pine, red pine, Scotch pine.
215E--------------- Goss	4f	Slight	Moderate	Slight	Slight	White oak-----------	60	Green ash, white oak, northern red oak.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
221B Palms	3w	Slight	Severe	Severe	Severe	Red maple	55	
						Silver maple	---	
						White ash	---	
						Northern white-cedar	---	
						Black ash	---	
249, 249C Zwingle	3w	Slight	Severe	Moderate	Moderate	Eastern cottonwood	90	Eastern cottonwood.
						Silver maple	80	
291 Atterberry	2o	Slight	Slight	Slight	Slight	Northern red oak	65	Eastern white pine, red pine, Norway spruce, silver maple, green ash.
						White oak	65	
						Silver maple	90	
						White ash	65	
						Green ash	65	
320 Arenzville	2o	Slight	Slight	Slight	Slight	Northern red oak	65	Red pine, eastern white pine, white spruce, northern red oak, black walnut.
						Bur oak	---	
						Silver maple	---	
462B Downs	2o	Slight	Slight	Slight	Slight	White oak	65	Eastern white pine, red pine, Norway spruce, white spruce, European larch, black walnut, sugar maple.
						Northern red oak	65	
463B, 463C Fayette	2o	Slight	Slight	Slight	Slight	White oak	65	Eastern white pine, red pine, Norway spruce, white spruce, European larch, black walnut, sugar maple.
						Northern red oak	65	
471 Oran	3w	Slight	Moderate	Slight	Slight	White oak	55	Eastern white pine, red pine, Norway spruce, white spruce, European larch, black walnut, sugar maple.
						Northern red oak	55	
478G*: Rock outcrop.								
Nordness	4d	Moderate	Moderate	Severe	Slight	Northern red oak	45	
						White oak	45	
480B, 480C, 480D2 Orwood	2o	Slight	Slight	Slight	Slight	White oak	65	Eastern white pine, red pine, Norway spruce, white spruce, European larch, black walnut, sugar maple.
						Northern red oak	65	
480E2 Orwood	2r	Moderate	Moderate	Slight	Slight	White oak	65	Eastern white pine, red pine, Norway spruce, white spruce, European larch, black walnut, sugar maple.
						Northern red oak	65	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordi- nation symbol	Management concerns: Erosion hazard	Management concerns: Equip- ment limita- tion	Management concerns: Seedling mortal- ity	Management concerns: Wind- throw hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
483C, 483D2: Frankville	2o	Slight	Slight	Slight	Slight	Northern red oak White oak	65 65	Eastern white pine, red pine, white oak, eastern redcedar, northern red oak, black walnut.
483E2: Frankville	2r	Moderate	Moderate	Slight	Slight	Northern red oak White oak	65 65	Eastern white pine, red pine, white oak, eastern redcedar, northern red oak, black walnut.
487B*:								
Otter	2w	Slight	Severe	Moderate	Moderate	Silver maple	94	Black spruce, green ash, pin oak, silver maple, eastern cottonwood, northern white-cedar.
Worthen	---	--------	--------	--------	--------		---	Black walnut, red maple, common hackberry, eastern white pine, green ash.
496B*:								
Dorchester	3o	Slight	Slight	Moderate	Slight	White oak Northern red oak	55 55	Ponderosa pine, Austrian pine, common hackberry, green ash, poplar.
Volney	3o	Slight	Slight	Slight	Slight	Northern red oak White oak	55 55	Eastern white pine, red pine, Scotch pine.
497E*, 497F*:								
Fayette	2r	Moderate	Moderate	Slight	Slight	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, white spruce, European larch, black walnut, sugar maple.
Dubuque	2r	Moderate	Moderate	Slight	Slight	Northern red oak White oak	65 65	Eastern white pine, red pine, eastern redcedar, Norway spruce, European larch, black walnut.
499B, 499D, 499F: Nordness	4d	Moderate	Moderate	Severe	Slight	Northern red oak White oak	45 45	
551: Calamine	4w	Slight	Severe	Severe	Severe	Silver maple White ash	70 ---	Silver maple, white ash, poplar.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
589, 589+ Otter	2w	Slight	Severe	Moderate	Moderate	Silver maple	94	Black spruce, green ash, pin oak, silver maple, eastern cottonwood, northern white-cedar.
714B, 714C Winneshiek	2o	Slight	Slight	Slight	Slight	Northern red oak	65	Eastern white pine, red pine, eastern redcedar, Norway spruce, European larch, black walnut.
						White oak	65	
763D2, 763D3 Exette	1o	Slight	Slight	Slight	Slight	White oak	80	Eastern white pine, red pine, white oak, northern red oak, green ash, eastern redcedar, black walnut.
						Northern red oak	80	
						Black walnut	---	
						Green ash	---	
						Sugar maple	---	
						American basswood	---	
						Black cherry	---	
763E2, 763E3, 763F2, 763F3 Exette	2r	Moderate	Moderate	Slight	Slight	White oak	80	Eastern white pine, red pine, white oak, northern red oak, green ash, eastern redcedar, black walnut.
						Northern red oak	80	
						Black walnut	---	
						Green ash	---	
						Sugar maple	---	
						American basswood	---	
						Black cherry	---	
776B, 776C Lilah	3s	Slight	Slight	Severe	Slight	Northern red oak	55	Eastern white pine, white oak, eastern redcedar.
777, 777B Wapsie	3o	Slight	Slight	Slight	Slight	Northern red oak	55	Eastern white pine, red pine, Norway spruce, white spruce, European larch, black walnut, sugar maple.
						White oak	55	
793 Bertrand	1o	Slight	Slight	Slight	Slight	Northern red oak	70+	Red pine, eastern white pine, white spruce, black walnut.
						White ash	---	
						White oak	---	
						Bur oak	---	
826 Rowley	4o	Slight	Slight	Slight	Slight	Silver maple	70	Silver maple, white ash, white spruce.
						Red maple	---	
						White ash	---	
863B, 863D Fayette	2o	Slight	Slight	Slight	Slight	White oak	65	Eastern white pine, red pine, Norway spruce, white spruce, European larch, black walnut, sugar maple.
						Northern red oak	65	
902C, 902D2 Luana	2o	Slight	Slight	Slight	Slight	White oak	65	Eastern white pine, red pine, northern red oak, green ash, common hackberry.
						Black walnut	65	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordi-nation symbol	Management concerns: Erosion hazard	Management concerns: Equip-ment limita-tion	Management concerns: Seedling mortal-ity	Management concerns: Wind-throw hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
926---------------- Canoe	2w	Slight	Moderate	Slight	Slight	White oak----------- Northern red oak----	65 65	Eastern white pine, red pine, sugar maple, Norway spruce, white spruce, European larch, poplar.
930, 930B---------- Orion	3o	Slight	Slight	Slight	Slight	Silver maple-------- Red maple----------- White ash-----------	80 --- ---	White spruce, silver maple, white ash, eastern cottonwood.
951F--------------- Medary Variant	4r	Moderate	Severe	Moderate	Moderate	Eastern cottonwood-- Silver maple--------	45 ---	Eastern cottonwood, white ash, silver maple.
978---------------- Festina	2o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak----	65 65	Eastern white pine, red pine, Norway spruce, white spruce, European larch, black walnut, sugar maple.
981B--------------- Worthen	---	--------	--------	--------	--------		---	Black walnut, red maple, common hackberry, eastern white pine, green ash.
1158--------------- Dorchester	3o	Slight	Slight	Moderate	Slight	White oak----------- Northern red oak----	55 55	Ponderosa pine, Austrian pine, common hackberry, green ash, poplar.
1212--------------- Kennebec	2o	Slight	Slight	Slight	Slight	Black walnut-------- Bur oak------------- Common hackberry---- Green ash----------- Eastern cottonwood--	79 63 --- --- ---	Black walnut, bur oak, common hackberry, green ash, eastern cottonwood.
1219--------------- Canoe Variant	2o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak----	65 65	Eastern white pine, red pine, sugar maple, Norway spruce, European larch.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
40----------------- Fayette	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Common hackberry, bur oak, eastern white pine, Austrian pine, green ash.	Silver maple.
41B, 41C----------- Sparta	Siberian peashrub	Eastern redcedar, Amur honeysuckle, lilac, Manchurian crabapple, Russian-olive, Tatarian honey-suckle.	Jack pine, red pine, Austrian pine.	Eastern white pine	---
63B, 63C----------- Chelsea	Siberian peashrub	Amur honeysuckle, eastern redcedar, Russian-olive, Tatarian honey-suckle, lilac, Manchurian crabapple.	Jack pine, Austrian pine, red pine.	Eastern white pine	---
63E---------------- Chelsea	Siberian peashrub	Amur honeysuckle, eastern redcedar, Russian-olive, Tatarian honey-suckle, lilac, Manchurian crabapple.	Jack pine, Austrian pine, red pine.	Eastern white pine	
65D2, 65F2, 65F3-- Lindley	---	Silky dogwood, Amur honeysuckle, Amur privet.	American cranberrybush, Washington hawthorn, northern white-cedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
83B---------------- Kenyon	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Common hackberry, bur oak, eastern white pine, red pine, green ash.	Silver maple.
84----------------- Clyde	---	Amur honeysuckle, northern white-cedar, redosier dogwood, Tatarian honeysuckle.	Norway spruce, Amur maple, eastern white pine, white spruce.	Silver maple, golden willow, green ash.	Eastern cottonwood.
98----------------- Huntsville	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
109B, 109C, 109D-- Backbone	---	Eastern redcedar, northern white-cedar, Russian-olive, Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Bur oak, ponderosa pine, jack pine, green ash, common hackberry.	---	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
110, 110B, 110C--- Lamont	---	Amur privet, Tatarian honeysuckle, lilac, American cranberrybush, Amur honeysuckle.	Eastern redcedar, northern white-cedar, osageorange.	Eastern white pine, Norway spruce, red pine, Austrian pine.	---
120B, 120C-------- Tama	---	Tatarian honeysuckle, lilac, Amur privet, American cranberrybush.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Red pine, Norway spruce.	Silver maple, eastern white pine.
129B*: Arenzville--------	---	Tatarian honeysuckle, lilac.	Northern white-cedar, Siberian crabapple, white spruce, Amur maple.	Green ash, common hackberry, red pine, bur oak, eastern white pine.	Silver maple.
Chaseburg--------	---	Tatarian honeysuckle, lilac.	Northern white-cedar, Siberian crabapple, white spruce, Amur maple.	Green ash, bur oak, eastern white pine, red pine, common hackberry.	Silver maple.
133--------------- Colo	---	Amur honeysuckle, northern white-cedar, redosier dogwood, Tatarian honeysuckle.	Siberian crabapple, Amur maple, eastern white pine, white spruce.	Silver maple, golden willow, green ash.	Eastern cottonwood.
136--------------- Ankeny	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Common hackberry, bur oak, eastern white pine, red pine, green ash.	Silver maple.
142--------------- Chaseburg	---	Tatarian honeysuckle, lilac.	Northern white-cedar, Siberian crabapple, white spruce, Amur maple.	Green ash, bur oak, eastern white pine, red pine, common hackberry.	Silver maple.
158--------------- Dorchester	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple.	Common hackberry, bur oak, eastern white pine, red pine, green ash.	---
162B, 162C, 162C2, 162D, 162D2, 162E2------------ Downs	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Common hackberry, bur oak, eastern white pine, red pine, green ash.	Silver maple.
163B, 163C, 163C2, 163D, 163D2, 163D3, 163E, 163E2, 163E3----- Fayette	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Common hackberry, bur oak, eastern white pine, Austrian pine, green ash.	Silver maple.
163F, 163F2, 163F3, 163G. Fayette					

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
171B, 171C2 Bassett	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple.
177, 177B Saude	Gray dogwood, silky dogwood.	Amur honeysuckle, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple, northern white-cedar.	Red pine, Norway spruce.	Eastern white pine, silver maple.
178 Waukee	Silky dogwood	Amur privet, Tatarian honeysuckle, American plum, American cranberrybush.	Amur maple, eastern redcedar, Austrian pine, northern white-cedar.	Red pine, Norway spruce, eastern white pine.	---
183C, 183D, 183D2 Dubuque	Siberian peashrub	Washington hawthorn, Manchurian crabapple, Tatarian honeysuckle, lilac, Amur honeysuckle, eastern redcedar.	Jack pine, red pine, white pine, Austrian pine.	---	---
183E, 183E2, 183E3, 183F. Dubuque					
196C Volney	---	Siberian peashrub, Tatarian honeysuckle.	Washington hawthorn, nannyberry viburnum, eastern redcedar, white spruce.	Green ash	---
213B, 214B Rockton	---	Silky dogwood, Amur privet, American cranberrybush, Tatarian honeysuckle, lilac.	Eastern redcedar, northern white-cedar, Amur maple, white spruce.	Eastern white pine, red pine, Norway spruce.	---
215E Goss	Siberian peashrub	Manchurian crabapple, lilac, Tatarian honeysuckle, Amur honeysuckle, Washington hawthorn.	Jack pine, eastern white pine, Austrian pine, red pine.	---	---
221B Palms	Common ninebark	Silky dogwood, Tatarian honeysuckle, nannyberry viburnum, Amur privet, Amur honeysuckle.	Tall purple willow	Black willow, golden willow.	Carolina poplar.
225, 226 Lawler	---	American plum, Tatarian honeysuckle, Siberian peashrub, lilac.	Eastern redcedar, northern white-cedar, white spruce, white fir.	Eastern white pine, Norway spruce, Austrian pine.	Pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
249, 249C: Zwingle	---	Silky dogwood, eastern redcedar, redosier dogwood, Tatarian honeysuckle.	Amur maple, white spruce, northern white-cedar.	Silver maple, golden willow, eastern white pine.	Eastern cottonwood, pin oak.
284, 284B: Flagler	Silky dogwood	Amur honeysuckle, Tatarian honeysuckle, American plum, Amur privet.	Eastern redcedar, Austrian pine, northern white-cedar.	Red pine, Norway spruce, common hackberry, eastern white pine.	---
291: Atterberry	Silky dogwood	American cranberrybush, lilac, Amur honeysuckle.	White spruce, white fir, northern white-cedar.	Norway spruce, Austrian pine.	Silver maple, pin oak, eastern white pine.
320: Arenzville	---	Tatarian honeysuckle, lilac.	Northern white-cedar, Siberian crabapple, white spruce, Amur maple.	Green ash, common hackberry, red pine, bur oak, eastern white pine.	Silver maple.
323B: Terril	---	Tatarian honeysuckle, lilac, Amur privet, American cranberrybush.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Red pine, Norway spruce.	Silver maple, eastern white pine.
391B*:					
Clyde	---	Amur honeysuckle, northern white-cedar, redosier dogwood, Tatarian honeysuckle.	Norway spruce, Amur maple, eastern white pine, white spruce.	Silver maple, golden willow, green ash.	Eastern cottonwood.
Floyd	---	Amur honeysuckle, northern white-cedar, redosier dogwood, Tatarian honeysuckle.	Siberian crabapple, Amur maple, eastern white pine, white spruce.	Silver maple, golden willow, green ash.	Eastern cottonwood.
408B, 408C: Olin	---	Amur honeysuckle, American plum, Tatarian honeysuckle, American cranberrybush.	Eastern redcedar, white fir, blue spruce.	Red pine, Norway spruce.	Eastern white pine, silver maple, pin oak.
444B, 444C, 444D: Jacwin	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, American plum.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
462B: Downs	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Common hackberry, bur oak, eastern white pine, red pine, green ash.	Silver maple.
463B, 463C: Fayette	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Common hackberry, bur oak, eastern white pine, Austrian pine, green ash.	Silver maple.
471: Oran	---	Tatarian honeysuckle, Amur privet, silky dogwood.	Eastern redcedar, Austrian pine, white fir, blue spruce, northern white-cedar.	Norway spruce	Eastern white pine, silver maple, pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
478G*: Rock outcrop.					
Nordness.					
480B, 480C, 480D2, 480E2: Orwood	---	Amur privet, Tatarian honeysuckle, American cranberrybush, silky dogwood.	Blue spruce, northern white-cedar, white fir.	Red pine, Norway spruce.	Pin oak, silver maple, eastern white pine.
483C, 483D2, 483E2: Frankville	Siberian peashrub	Washington hawthorn, Tatarian honeysuckle, lilac, Amur honeysuckle, eastern redcedar, Manchurian crabapple.	Jack pine, red pine, eastern white pine, Austrian pine.	---	---
485: Spillville	---	Tatarian honeysuckle, lilac, Amur privet, American cranberrybush.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Austrian pine, Norway spruce.	Silver maple, eastern white pine.
487B*: Otter	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, white fir, blue spruce, northern white-cedar, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.
Worthen	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
489: Ossian	---	American cranberrybush, Tatarian honeysuckle, silky dogwood, Amur privet.	Eastern redcedar, white spruce, white fir, northern white-cedar, Norway spruce, Austrian pine.	Eastern white pine	Pin oak.
490: Caneek	---	American plum, Tatarian honeysuckle.	Washington hawthorn, eastern redcedar, osageorange, green ash, white spruce, blue spruce.	Black willow	Eastern cottonwood, golden willow.
496B*: Dorchester	---	Tatarian honeysuckle, lilac, Siberian peashrub.	Northern white-cedar, white spruce, osageorange.	Black willow, common hackberry, bur oak, green ash.	Golden willow, eastern cottonwood.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
496B*:					
Volney	---	Siberian peashrub, Tatarian honeysuckle.	Washington hawthorn, nannyberry viburnum, eastern redcedar, white spruce.	Silver maple	---
497E*:					
Fayette	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Common hackberry, bur oak, eastern white pine, Austrian pine, green ash.	Silver maple.
Dubuque	Siberian peashrub	Washington hawthorn, lilac, Tatarian honeysuckle, Amur honeysuckle, Manchurian crabapple, eastern redcedar.	Jack pine, red pine, Austrian pine, white pine.	---	---
497F*:					
Fayette.					
Dubuque.					
499B, 499D. Nordness					
499F. Nordness					
512B, 512D2 Marlean	Siberian peashrub, lilac.	Eastern redcedar, Tatarian honeysuckle, Amur honeysuckle.	Austrian pine	---	---
551 Calamine	---	Tatarian honeysuckle.	Osageorange, northern white-cedar, blue spruce, white spruce, Washington hawthorn, eastern redcedar.	Black willow, golden willow.	Eastern cottonwood.
589, 589+ Otter	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, white fir, blue spruce, northern white-cedar, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.
612D2, 612E2 Mottland	Tatarian honeysuckle, Siberian peashrub.	---	Russian-olive, eastern redcedar.	Green ash, common hackberry.	---
714B, 714C Winneshiek	Siberian peashrub	Eastern redcedar, American plum, Tatarian honeysuckle, lilac, Amur honeysuckle, Manchurian crabapple.	Eastern white pine, red pine, Austrian pine, jack pine.	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
763D2, 763D3, 763E2, 763E3----- Exette	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, eastern white pine, common hackberry.	Silver maple.
763F2, 763F3. Exette					
776B, 776C--------- Lilah	Siberian peashrub	Manchurian crab-apple, eastern redcedar, Russian-olive, Tatarian honey-suckle, lilac, Amur honeysuckle.	Jack pine, Austrian pine, red pine.	Eastern white pine	---
777, 777B--------- Wapsie	---	Lilac, Tatarian honeysuckle, Amur privet, American cranberrybush.	Eastern redcedar, Amur maple, Austrian pine, northern white-cedar.	Eastern white pine, red pine, Norway spruce.	---
793--------------- Bertrand	---	Tatarian honeysuckle, lilac.	Northern white-cedar, Siberian crabapple, white spruce, Amur maple.	Green ash, bur oak, eastern white pine, red pine, common hackberry.	Silver maple.
826--------------- Rowley	---	American cranberybush, Amur privet, redosier dogwood, nannyberry viburnum, Amur honeysuckle.	White spruce, white fir, northern white-cedar.	Jack pine, Norway spruce.	Eastern white-pine, silver maple.
863B, 863D-------- Fayette	---	Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple.	Common hackberry, bur oak, eastern white pine, Austrian pine, green ash.	Silver maple.
902C, 902D2------- Luana	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, eastern white pine, Norway spruce, red pine.	Silver maple.
926--------------- Canoe	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
930, 930B--------- Orion	---	Amur honeysuckle, American cranberrybush, silky dogwood, Amur privet.	White spruce, northern white-cedar, eastern redcedar.	Red pine, Norway spruce.	Eastern white pine, pin oak.
951F-------------- Medary Variant	Silky dogwood, gray dogwood.	Northern white-cedar, Tatarian honeysuckle, Amur honeysuckle, lilac.	Eastern redcedar, red pine, eastern white pine, Austrian pine, Norway spruce.	Pin oak-----------	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
977. Richwood	---	Tatarian honeysuckle, lilac, Amur privet, American cranberrybush.	Northern white-cedar, white spruce, Amur maple, white fir.	Red pine, Norway spruce.	Pin oak, eastern white pine.
978. Festina	Gray dogwood	Redosier dogwood, American plum, Tatarian honeysuckle, silky dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
981B. Worthen	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
1158. Dorchester	---	Tatarian honeysuckle, lilac, Siberian peashrub.	Northern white-cedar, white spruce, osageorange.	Black willow, common hackberry, bur oak, green ash.	Golden willow, eastern cottonwood.
1212. Kennebec	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
1219. Canoe Variant	Gray dogwood, silky dogwood.	Tatarian honeysuckle, lilac, autumn-olive, redosier dogwood.	Amur maple, eastern redcedar.	Common hackberry, Norway spruce.	Silver maple, eastern cottonwood.
1490. Caneek	---	American plum, Tatarian honeysuckle.	Washington hawthorn, eastern redcedar, osageorange, green ash, white spruce, blue spruce.	Black willow	Eastern cottonwood, golden willow.
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
40 Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
41B Sparta	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
41C Sparta	Slight	Slight	Severe: slope.	Slight	Moderate: droughty.
63B Chelsea	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
63C Chelsea	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope, droughty.
63E Chelsea	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
65D2 Lindley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
65F2, 65F3 Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
83B Kenyon	Slight	Slight	Moderate: slope.	Slight	Slight.
84 Clyde	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
98 Huntsville	Severe: flooding.	Slight	Slight	Slight	Slight.
109B Backbone	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock.	Slight	Moderate: thin layer.
109C Backbone	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Moderate: thin layer.
109D Backbone	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope, thin layer.
110 Lamont	Slight	Slight	Slight	Slight	Slight.
110B Lamont	Slight	Slight	Moderate: slope.	Slight	Slight.
110C Lamont	Slight	Slight	Severe: slope.	Slight	Slight.
120B Tama	Slight	Slight	Moderate: slope.	Slight	Slight.
120C Tama	Slight	Slight	Severe: slope.	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
129B*:					
Arenzville	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Chaseburg	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Severe: erodes easily.	Severe: flooding.
133 Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
136 Ankeny	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
142 Chaseburg	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Severe: erodes easily.	Severe: flooding.
158 Dorchester	Severe: flooding.	Slight	Slight	Slight	Slight.
162B Downs	Slight	Slight	Moderate: slope.	Slight	Slight.
162C, 162C2 Downs	Slight	Slight	Severe: slope.	Slight	Slight.
162D, 162D2 Downs	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
162E2 Downs	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
163B Fayette	Slight	Slight	Moderate: slope.	Slight	Slight.
163C, 163C2 Fayette	Slight	Slight	Severe: slope.	Slight	Slight.
163D, 163D2, 163D3 Fayette	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
163E, 163E2, 163E3, 163F, 163F2, 163F3 Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
163G Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
171B Bassett	Slight	Slight	Moderate: slope.	Slight	Slight.
171C2 Bassett	Slight	Slight	Severe: slope.	Slight	Slight.
177 Saude	Slight	Slight	Slight	Slight	Slight.
177B Saude	Slight	Slight	Moderate: slope.	Slight	Slight.
178 Waukee	Slight	Slight	Slight	Slight	Slight.
183C Dubuque	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: thin layer.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
183D, 183D2: Dubuque	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope, thin layer.
183E, 183E2, 183E3, 183F: Dubuque	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
196C: Volney	Severe: flooding.	Moderate: flooding, small stones.	Severe: small stones, flooding.	Moderate: large stones, flooding.	Severe: flooding.
213B, 214B: Rockton	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: thin layer.
215E: Goss	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Severe: droughty.
221B: Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
225, 226: Lawler	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
249, 249C: Zwingle	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
284: Flagler	Slight	Slight	Slight	Slight	Slight.
284B: Flagler	Slight	Slight	Moderate: slope.	Slight	Slight.
291: Atterberry	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
320: Arenzville	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
323B: Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
391B*:					
Clyde	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Floyd	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Slight.
408B: Olin	Slight	Slight	Moderate: slope.	Slight	Slight.
408C: Olin	Slight	Slight	Severe: slope.	Slight	Slight.
444B: Jacwin	Severe: percs slowly, excess humus.	Severe: excess humus, percs slowly.	Severe: excess humus, percs slowly.	Severe: excess humus.	Moderate: thin layer.
444C: Jacwin	Severe: percs slowly, excess humus.	Severe: excess humus, percs slowly.	Severe: slope, excess humus, percs slowly.	Severe: excess humus.	Moderate: thin layer.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
444D------------------ Jacwin	Severe: percs slowly, excess humus.	Severe: excess humus, percs slowly.	Severe: slope, excess humus, percs slowly.	Severe: excess humus.	Moderate: slope, thin layer.
462B------------------ Downs	Slight----------	Slight----------	Moderate: slope.	Slight------------	Slight.
463B------------------ Fayette	Slight----------	Slight----------	Moderate: slope.	Slight------------	Slight.
463C------------------ Fayette	Slight----------	Slight----------	Severe: slope.	Slight------------	Slight.
471------------------- Oran	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight------------	Slight.
478G*: Rock outcrop.					
Nordness--------------	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope, erodes easily.	Severe: slope, thin layer.
480B------------------ Orwood	Slight----------	Slight----------	Moderate: slope.	Slight------------	Slight.
480C------------------ Orwood	Slight----------	Slight----------	Severe: slope.	Slight------------	Slight.
480D2----------------- Orwood	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight------------	Moderate: slope.
480E2----------------- Orwood	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
483C------------------ Frankville	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight------------	Moderate: thin layer.
483D2----------------- Frankville	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight------------	Moderate: slope, thin layer.
483E2----------------- Frankville	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
485------------------- Spillville	Severe: flooding.	Slight----------	Moderate: flooding.	Slight------------	Moderate: flooding.
487B*: Otter----------------	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
Worthen--------------	Slight----------	Slight----------	Moderate: slope.	Slight------------	Slight.
489------------------- Ossian	Severe: wetness, flooding.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
490------------------- Caneek	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
496B*: Dorchester-----------	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
496B*:					
Volney	Severe: flooding.	Moderate: small stones.	Severe: small stones.	Moderate: large stones.	Moderate: small stones, large stones, flooding.
497E*, 497F*:					
Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Dubuque	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
499B Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: thin layer.
499D Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.	Severe: thin layer.
499F Nordness	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: erodes easily.	Severe: slope, thin layer.
512B Marlean	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones, large stones.
512D2 Marlean	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones.
551 Calamine	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
589, 589+ Otter	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
612D2 Mottland	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, slope.
612E2 Mottland	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
714B Winneshiek	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock, percs slowly.	Slight	Moderate: thin layer.
714C Winneshiek	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Moderate: thin layer.
763D2, 763D3 Exette	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
763E2, 763E3, 763F2, 763F3 Exette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
776B Lilah	Slight	Slight	Moderate: slope, small stones.	Slight	Severe: droughty.
776C Lilah	Slight	Slight	Severe: slope.	Slight	Severe: droughty.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
777 Wapsie	Slight	Slight	Slight	Slight	Slight.
777B Wapsie	Slight	Slight	Moderate: slope.	Slight	Slight.
793 Bertrand	Slight	Slight	Slight	Severe: erodes easily.	Slight.
826 Rowley	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
863B Fayette	Slight	Slight	Moderate: slope.	Slight	Slight.
863D Fayette	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
902C Luana	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Slight.
902D2 Luana	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
926 Canoe	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
930, 930B Orion	Severe: flooding, wetness.	Moderate: wetness, flooding.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
951F Medary Variant	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
977 Richwood	Slight	Slight	Slight	Slight	Slight.
978 Festina	Slight	Slight	Slight	Slight	Slight.
981B Worthen	Slight	Slight	Moderate: slope.	Slight	Slight.
1158 Dorchester	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
1212 Kennebec	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
1219 Canoe Variant	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
1490 Caneek	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
40----------------- Fayette	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
41B---------------- Sparta	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
41C---------------- Sparta	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
63B---------------- Chelsea	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
63C, 63E----------- Chelsea	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
65D2--------------- Lindley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
65F2, 65F3--------- Lindley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
83B---------------- Kenyon	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
84----------------- Clyde	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
98----------------- Huntsville	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
109B--------------- Backbone	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
109C, 109D--------- Backbone	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
110, 110B---------- Lamont	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
110C--------------- Lamont	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
120B--------------- Tama	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
120C--------------- Tama	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
129B*:										
Arenzville---------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Chaseburg----------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
133---------------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
136---------------- Ankeny	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
142---------------- Chaseburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
158: Dorchester	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Poor.
162B: Downs	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
162C, 162C2, 162D, 162D2: Downs	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
162E2: Downs	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
163B: Fayette	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163C, 163C2, 163D, 163D2, 163D3: Fayette	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163E, 163E2, 163E3, 163F, 163F2, 163F3: Fayette	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
163G: Fayette	Very poor.	Very poor.	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.
171B: Bassett	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
171C2: Bassett	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
177, 177B: Saude	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
178: Waukee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
183C, 183D, 183D2: Dubuque	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
183E, 183E2, 183E3, 183F: Dubuque	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
196C: Volney	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
213B, 214B: Rockton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
215E: Goss	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
221B: Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
225, 226: Lawler	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
249: Zwingle	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
249C------ Zwingle	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
284, 284B------ Flagler	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
291------ Atterberry	Fair	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
320------ Arenzville	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
323B------ Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
391B*:										
Clyde------	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Floyd------	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
408B------ Olin	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
408C------ Olin	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
444B------ Jacwin	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
444C, 444D------ Jacwin	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor.
462B------ Downs	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
463B------ Fayette	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
463C------ Fayette	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
471------ Oran	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
478G*: Rock outcrop.										
Nordness------	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
480B------ Orwood	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
480C, 480D2------ Orwood	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
480E2------ Orwood	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
483C, 483D2------ Frankville	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
483E2------ Frankville	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
485-----Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
487B*:										
Otter-----	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Worthen-----	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
489-----Ossian	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
490-----Caneek	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Poor	Good.
496B*:										
Dorchester-----	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Poor.
Volney-----	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
497E*, 497F*:										
Fayette-----	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Dubuque-----	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
499B, 499D-----Nordness	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
499F-----Nordness	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
512B, 512D2-----Marlean	Very poor.	Very poor.	Fair	Fair	Fair	Very poor.	Very poor.	Very poor.	Poor	Very poor.
551-----Calamine	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
589, 589+-----Otter	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
612D2-----Mottland	Poor	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Very poor.	Very poor.
612E2-----Mottland	Very poor.	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
714B-----Winneshiek	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
714C-----Winneshiek	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
763D2, 763D3-----Exette	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
763E2, 763E3, 763F2, 763F3-----Exette	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
776B-----Lilah	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
776C---------------- Lilah	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
777, 777B---------- Wapsie	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
793---------------- Bertrand	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
826---------------- Rowley	Good	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
863B--------------- Fayette	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
863D--------------- Fayette	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
902C, 902D2-------- Luana	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
926---------------- Canoe	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
930, 930B---------- Orion	Fair	Fair	Good	Good	Good	Good	Fair	Good	Good	Good.
951F--------------- Medary Variant	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
977---------------- Richwood	Good	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
978---------------- Festina	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
981B--------------- Worthen	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
1158--------------- Dorchester	Poor	Poor	Fair	Fair	Poor	Fair	Poor	Poor	Poor	Poor.
1212--------------- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
1219--------------- Canoe Variant	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1490--------------- Caneek	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Poor	Good.
5010*, 5030*. Pits										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
40----------------- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.	Severe: slope.
41B---------------- Sparta	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
41C---------------- Sparta	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
63B---------------- Chelsea	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
63C---------------- Chelsea	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope, droughty.
63E---------------- Chelsea	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
65D2--------------- Lindley	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
65F2, 65F3--------- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
83B---------------- Kenyon	Slight---------	Slight---------	Slight---------	Slight---------	Severe: low strength.	Slight.
84----------------- Clyde	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
98----------------- Huntsville	Slight---------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.
109B--------------- Backbone	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, frost action.	Moderate: thin layer.
109C--------------- Backbone	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, frost action.	Moderate: thin layer.
109D--------------- Backbone	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, frost action.	Moderate: slope, thin layer.
110, 110B---------- Lamont	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
110C--------------- Lamont	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
120B--------------- Tama	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
120C-------------- Tama	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
129B*:						
Arenzville-------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Severe: flooding.
Chaseburg--------	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Severe: flooding.
133--------------- Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
136--------------- Ankeny	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
142--------------- Chaseburg	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Severe: flooding.
158--------------- Dorchester	Severe: excess humus.	Severe: flooding.	Severe: flooding, low strength.	Severe: flooding.	Severe: frost action.	Slight.
162B-------------- Downs	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
162C, 162C2------- Downs	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
162D, 162D2------- Downs	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
162E2------------- Downs	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action, low strength.	Severe: slope.
163B-------------- Fayette	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
163C, 163C2------- Fayette	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
163D, 163D2, 163D3------------ Fayette	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G------------- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.	Severe: slope.
171B-------------- Bassett	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
171C2: Bassett	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
177, 177B: Saude	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
178: Waukee	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.	Slight.
183C: Dubuque	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength, frost action.	Moderate: thin layer.
183D, 183D2: Dubuque	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope, thin layer.
183E, 183E2, 183E3, 183F: Dubuque	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
196C: Volney	Moderate: dense layer, large stones, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
213B, 214B: Rockton	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.	Moderate: thin layer.
215E: Goss	Moderate: too clayey, large stones, slope.	Moderate: shrink-swell, slope, large stones.	Moderate: slope, shrink-swell, large stones.	Severe: slope.	Moderate: low strength, slope, frost action.	Severe: droughty.
221B: Palms	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
225, 226: Lawler	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
249, 249C: Zwingle	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, low strength.	Moderate: wetness.
284, 284B: Flagler	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
291: Atterberry	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
320: Arenzville	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Severe: flooding.
323B: Terril	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
391B*:						
Clyde	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Floyd	Severe: cutbanks cave, excess humus, wetness.	Severe: low strength.	Severe: wetness.	Severe: low strength.	Severe: low strength, frost action.	Slight.
408B Olin	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
408C Olin	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
444B Jacwin	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: thin layer.
444C Jacwin	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: thin layer.
444D Jacwin	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: wetness.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope, thin layer.
462B Downs	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
463B Fayette	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
463C Fayette	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
471 Oran	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
478G*:						
Rock outcrop.						
Nordness	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, thin layer.
480B Orwood	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
480C Orwood	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.	Slight.
480D2 Orwood	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
480E2 Orwood	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
483C Frankville	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength, frost action.	Moderate: thin layer.
483D2 Frankville	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope, thin layer.
483E2 Frankville	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
485 Spillville	Moderate: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
487B*:						
Otter	Severe: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
Worthen	Slight	Slight	Slight	Slight	Severe: low strength, frost action.	Slight.
489 Ossian	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
490 Caneek	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Severe: flooding.
496B*:						
Dorchester	Severe: excess humus.	Severe: flooding.	Severe: flooding, low strength.	Severe: flooding.	Severe: flooding, frost action.	Severe: flooding.
Volney	Moderate: dense layer, large stones, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: small stones, large stones, flooding.
497E*, 497F*:						
Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.	Severe: slope.
Dubuque	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
499B Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
499D Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: thin layer.
499F Nordness	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, thin layer.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
512B-------------- Marlean	Moderate: dense layer, large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: small stones, large stones.
512D2------------- Marlean	Moderate: dense layer, large stones, slope.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Moderate: small stones.
551--------------- Calamine	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength.	Severe: wetness.
589, 589+--------- Otter	Severe: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
612D2------------- Mottland	Moderate: large stones, slope.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Moderate: large stones, slope.
612E2------------- Mottland	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
714B-------------- Winneshiek	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, low strength.	Moderate: thin layer.
714C-------------- Winneshiek	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, low strength.	Moderate: thin layer.
763D2, 763D3------ Exette	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
763E2, 763E3, 763F2, 763F3----- Exette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
776B-------------- Lilah	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
776C-------------- Lilah	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: droughty.
777, 777B--------- Wapsie	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
793--------------- Bertrand	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
826--------------- Rowley	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
863B-------------- Fayette	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
863D-------------- Fayette	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
902C Luana	Moderate: too clayey.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
902D2 Luana	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
926 Canoe	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Slight.
930, 930B Orion	Severe: wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: flooding, frost action.	Severe: flooding.
951F Medary Variant	Severe: cutbanks cave, slope.	Severe: shrink-swell, slope.	Severe: slope.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
977 Richwood	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action.	Slight.
978 Festina	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
981B Worthen	Slight	Slight	Slight	Slight	Severe: low strength, frost action.	Slight.
1158 Dorchester	Severe: excess humus.	Severe: flooding.	Severe: flooding, low strength.	Severe: flooding.	Severe: flooding, frost action.	Severe: flooding.
1212 Kennebec	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
1219 Canoe Variant	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
1490 Caneek	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Severe: flooding.
5010*, 5030*. Pits						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
40 Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
41B Sparta	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
41C Sparta	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
63B Chelsea	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
63C Chelsea	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
63E Chelsea	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy, slope.	Severe: seepage, slope.	Poor: too sandy, slope, seepage.
65D2 Lindley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
65F2, 65F3 Lindley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
83B Kenyon	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
84 Clyde	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
98 Huntsville	Moderate: flooding, percs slowly.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Good.
109B Backbone	Severe: depth to rock, percs slowly.	Severe: seepage, depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: area reclaim.
109C, 109D Backbone	Severe: depth to rock, percs slowly.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: area reclaim.
110, 110B Lamont	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
110C Lamont	Slight	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Good.
120B Tama	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
120C Tama	Slight	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
129B*:					
Arenzville	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, too sandy.	Severe: flooding, wetness.	Poor: too sandy.
Chaseburg	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
133 Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
136 Ankeny	Severe: flooding, poor filter.	Severe: flooding, seepage.	Severe: flooding, seepage.	Severe: flooding, seepage.	Fair: thin layer.
142 Chaseburg	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
158 Dorchester	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Poor: thin layer.
162B Downs	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
162C, 162C2 Downs	Slight	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
162D, 162D2 Downs	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
162E2 Downs	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
163B Fayette	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
163C, 163C2 Fayette	Slight	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
163D, 163D2, 163D3 Fayette	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
171B Bassett	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
171C2 Bassett	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
177, 177B Saude	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
178----------------- Waukee	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy, seepage.
183C, 183D, 183D2--- Dubuque	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
183E, 183E2, 183E3, 183F--------------- Dubuque	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
196C---------------- Volney	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, large stones.	Severe: flooding, seepage.	Poor: seepage, small stones.
213B, 214B---------- Rockton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
215E---------------- Goss	Moderate: percs slowly, slope, large stones.	Severe: seepage, slope.	Severe: too clayey, large stones.	Severe: seepage.	Poor: too clayey, small stones.
221B---------------- Palms	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
225, 226------------ Lawler	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
249----------------- Zwingle	Severe: percs slowly, wetness.	Slight-----------	Severe: too clayey, wetness.	Severe: wetness.	Poor: wetness, too clayey.
249C---------------- Zwingle	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: wetness, too clayey.
284, 284B----------- Flagler	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
291----------------- Atterberry	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
320----------------- Arenzville	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, too sandy.	Severe: flooding, wetness.	Poor: too sandy.
323B---------------- Terril	Slight-----------	Severe: seepage.	Severe: seepage.	Slight-----------	Good.
391B*:					
Clyde---------------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Floyd---------------	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
408B----------------- Olin	Slight-----------	Moderate: slope, seepage.	Slight-----------	Slight-----------	Good.
408C----------------- Olin	Slight-----------	Severe: slope.	Slight-----------	Slight-----------	Good.
444B----------------- Jacwin	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, wetness.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
444C, 444D---------- Jacwin	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
462B----------------- Downs	Slight-----------	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
463B----------------- Fayette	Slight-----------	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
463C----------------- Fayette	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
471------------------ Oran	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
478G*: Rock outcrop.					
Nordness------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Poor: area reclaim, slope.
480B----------------- Orwood	Slight-----------	Moderate: slope, seepage.	Slight-----------	Slight-----------	Good.
480C----------------- Orwood	Slight-----------	Severe: slope.	Slight-----------	Slight-----------	Good.
480D2---------------- Orwood	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
480E2---------------- Orwood	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
483C, 483D2---------- Frankville	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
483E2---------------- Frankville	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
485------------------ Spillville	Severe: wetness, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, flooding.	Fair: wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
487B*:					
Otter	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Poor: wetness.
Worthen	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
489 Ossian	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
490 Caneek	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
496B*:					
Dorchester	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Poor: thin layer.
Volney	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, large stones.	Severe: flooding, seepage.	Poor: seepage, small stones.
497E*, 497F*:					
Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Dubuque	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
499B Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
499D Nordness	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
499F Nordness	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Poor: area reclaim, slope.
512B Marlean	Moderate: large stones.	Severe: seepage.	Severe: seepage, large stones.	Severe: seepage.	Poor: small stones.
512D2 Marlean	Moderate: large stones, slope.	Severe: seepage, slope.	Severe: seepage, large stones.	Severe: seepage.	Poor: small stones.
551 Calamine	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
589, 589+ Otter	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Poor: wetness.
612D2 Mottland	Moderate: slope, large stones.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Poor: large stones.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
612E2----------------- Mottland	Severe: slope.	Severe: slope, seepage.	Severe: slope, seepage.	Severe: seepage, slope.	Poor: slope, large stones.
714B----------------- Winneshiek	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
714C----------------- Winneshiek	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
763D2, 763D3--------- Exette	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
763E2, 763E3, 763F2, 763F3-------------- Exette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
776B----------------- Lilah	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
776C----------------- Lilah	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
777, 777B------------ Wapsie	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
793------------------ Bertrand	Slight------------	Severe: seepage.	Severe: seepage.	Slight------------	Fair: too clayey, thin layer.
826------------------ Rowley	Severe: flooding, wetness.	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
863B----------------- Fayette	Slight------------	Moderate: slope, seepage.	Moderate: too clayey.	Slight------------	Fair: too clayey.
863D----------------- Fayette	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
902C----------------- Luana	Slight------------	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: large stones.
902D2---------------- Luana	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: large stones.
926------------------ Canoe	Severe: wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
930, 930B------------ Orion	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
951F----------------- Medary Variant	Severe: wetness, percs slowly, slope.	Severe: seepage, slope, wetness.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope.
977------------------ Richwood	Slight-----------	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: too clayey, thin layer.
978------------------ Festina	Slight-----------	Moderate: seepage.	Severe: seepage.	Slight-----------	Fair: too clayey.
981B----------------- Worthen	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
1158----------------- Dorchester	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Poor: thin layer.
1212----------------- Kennebec	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
1219----------------- Canoe Variant	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
1490----------------- Caneek	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
40 Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
41B, 41C Sparta	Good	Probable	Improbable: too sandy.	Fair: too sandy.
63B Chelsea	Good	Probable	Improbable: too sandy.	Fair: too sandy.
63C Chelsea	Good	Probable	Improbable: too sandy.	Fair: too sandy, slope.
63E Chelsea	Fair: slope.	Probable	Improbable: too sandy.	Poor: slope.
65D2 Lindley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
65F2, 65F3 Lindley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
83B Kenyon	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
84 Clyde	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
98 Huntsville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
109B, 109C Backbone	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
109D Backbone	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
110, 110B, 110C Lamont	Good	Probable	Improbable: too sandy.	Good.
120B, 120C Tama	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
129B*:				
Arenzville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Chaseburg	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
133 Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
136 Ankeny	Good	Probable	Improbable: too sandy.	Good.
142 Chaseburg	Good	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
158: Dorchester	Fair: low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
162B, 162C, 162C2: Downs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
162D, 162D2: Downs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
162E2: Downs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
163B, 163C, 163C2: Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
163D, 163D2: Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, thin layer.
163D3: Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
163E, 163E2, 163E3, 163F, 163F2, 163F3: Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
163G: Fayette	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
171B, 171C2: Bassett	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
177, 177B: Saude	Good.	Probable.	Probable.	Good.
178: Waukee	Good.	Probable.	Improbable: too sandy.	Good.
183C: Dubuque	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
183D, 183D2: Dubuque	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, slope.
183E, 183E2, 183E3, 183F: Dubuque	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
196C: Volney	Fair: large stones.	Improbable: large stones.	Improbable: large stones.	Poor: small stones, area reclaim.
213B, 214B: Rockton	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
215E: Goss	Fair: low strength, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
221B: Palms	Poor: wetness.	Improbable: excess humus, excess fines.	Improbable: excess humus, excess fines.	Poor: wetness, excess humus.
225, 226: Lawler	Fair: wetness.	Probable	Probable	Poor: area reclaim.
249, 249C: Zwingle	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
284, 284B: Flagler	Good	Probable	Probable	Fair: small stones, area reclaim, thin layer.
291: Atterberry	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
320: Arenzville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
323B: Terril	Good	Probable	Improbable: too sandy.	Good.
391B*:				
Clyde	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Floyd	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
408B, 408C: Olin	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
444B, 444C: Jacwin	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
444D: Jacwin	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, slope.
462B: Downs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
463B, 463C: Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
471: Oran	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
478G*:				
Rock outcrop.				
Nordness	Poor: area reclaim, thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
480B, 480C: Orwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
480D2: Orwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
480E2: Orwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
483C: Frankville	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
483D2: Frankville	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, slope.
483E2: Frankville	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
485: Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
487B*:				
Otter	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Worthen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
489: Ossian	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
490: Caneek	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
496B*:				
Dorchester	Fair: low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
Volney	Fair: large stones.	Improbable: large stones.	Improbable: large stones.	Poor: small stones, area reclaim.
497E*, 497F*:				
Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Dubuque	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
499B, 499D: Nordness	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
499F: Nordness	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
512B, 512D2: Marlean	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
551: Calamine	Poor: area reclaim, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
589, 589+: Otter	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
612D2----------------- Mottland	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
612E2----------------- Mottland	Fair: large stones, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, area reclaim, large stones.
714B, 714C------------ Winneshiek	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
763D2, 763D3---------- Exette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
763E2, 763E3, 763F2, 763F3---------------- Exette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
776B, 776C------------ Lilah	Good-----------------	Probable-------------	Probable-------------	Poor: small stones, area reclaim.
777, 777B------------- Wapsie	Good-----------------	Probable-------------	Probable-------------	Fair: small stones, area reclaim, thin layer.
793------------------- Bertrand	Good-----------------	Probable-------------	Improbable: too sandy.	Good.
826------------------- Rowley	Fair: wetness.	Probable-------------	Improbable: too sandy.	Good.
863B------------------ Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
863D------------------ Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, thin layer.
902C, 902D2----------- Luana	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
926------------------- Canoe	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
930, 930B------------- Orion	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
951F------------------ Medary Variant	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
977------------------- Richwood	Good-----------------	Probable-------------	Improbable: too sandy.	Good.
978------------------- Festina	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
981B------------------ Worthen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1158------------------ Dorchester	Fair: low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1212------------------ Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1219------------------ Canoe Variant	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1490------------------ Caneek	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
5010*, 5030*. Pits				
5040*. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
40 Fayette	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope	Slope, erodes easily.
41B, 41C Sparta	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
63B Chelsea	Severe: seepage.	Severe: piping, seepage.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
63C, 63E Chelsea	Severe: slope, seepage.	Severe: piping, seepage.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
65D2, 65F2, 65F3 Lindley	Severe: slope.	Slight	Deep to water	Slope	Slope	Slope.
83B Kenyon	Moderate: slope, seepage.	Slight	Deep to water	Slope	Favorable	Favorable.
84 Clyde	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness, erodes easily.
98 Huntsville	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable	Favorable	Favorable.
109B, 109C Backbone	Severe: seepage.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock.	Depth to rock, soil blowing.	Depth to rock, rooting depth.
109D Backbone	Severe: seepage, slope.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock.	Slope, depth to rock, soil blowing.	Slope, depth to rock, rooting depth.
110 Lamont	Severe: seepage.	Moderate: thin layer.	Deep to water	Soil blowing	Soil blowing	Favorable.
110B, 110C Lamont	Severe: seepage.	Moderate: thin layer.	Deep to water	Slope, soil blowing.	Soil blowing	Favorable.
120B, 120C Tama	Moderate: slope, seepage.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
129B*:						
Arenzville	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily, too sandy.	Erodes easily.
Chaseburg	Moderate: seepage, slope.	Severe: piping.	Deep to water	Flooding, slope.	Erodes easily	Erodes easily.
133 Colo	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Flooding, wetness.	Wetness	Wetness.
136 Ankeny	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing	Favorable.
142 Chaseburg	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Erodes easily	Erodes easily.
158 Dorchester	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
162B, 162C, 162C2-- Downs	Moderate: slope, seepage.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
162D, 162D2, 162E2-- Downs	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
163B, 163C, 163C2-- Fayette	Moderate: slope, seepage.	Slight	Deep to water	Slope, erodes easily.	Favorable	Erodes easily.
163D, 163D2, 163D3, 163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G-- Fayette	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope	Slope, erodes easily.
171B, 171C2-- Bassett	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
177-- Saude	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
177B-- Saude	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.
178-- Waukee	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
183C-- Dubuque	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
183D, 183D2, 183E, 183E2, 183E3, 183F-- Dubuque	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
196C-- Volney	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, rooting depth, slope.	Large stones	Large stones, rooting depth.
213B, 214B-- Rockton	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
215E-- Goss	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
221B-- Palms	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
225, 226-- Lawler	Severe: seepage.	Severe: seepage.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.
249-- Zwingle	Slight	Severe: wetness.	Percs slowly	Percs slowly, wetness.	Erodes easily, wetness.	Wetness, erodes easily.
249C-- Zwingle	Moderate: slope.	Severe: wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
284--------------- Flagler	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing---	Too sandy, soil blowing.	Favorable.
284B-------------- Flagler	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
291--------------- Atterberry	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness---------	Erodes easily, wetness.	Wetness, erodes easily.
320--------------- Arenzville	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily, too sandy.	Erodes easily.
323B-------------- Terril	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope-----------	Favorable-------	Favorable.
391B*: Clyde------------	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness---------	Wetness---------	Wetness, erodes easily.
Floyd------------	Severe: seepage.	Moderate: piping, wetness.	Frost action---	Wetness---------	Wetness---------	Favorable.
408B, 408C-------- Olin	Moderate: slope, seepage.	Slight----------	Deep to water	Soil blowing, slope.	Soil blowing---	Favorable.
444B, 444C-------- Jacwin	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Percs slowly, depth to rock, frost action.	Wetness, percs slowly, depth to rock.	Depth to rock, wetness.	Depth to rock, rooting depth.
444D-------------- Jacwin	Severe: slope.	Severe: thin layer.	Percs slowly, depth to rock, frost action.	Wetness, percs slowly, depth to rock.	Slope, depth to rock, wetness.	Slope, depth to rock, rooting depth.
462B-------------- Downs	Moderate: slope, seepage.	Slight----------	Deep to water	Slope-----------	Erodes easily	Erodes easily.
463B, 463C-------- Fayette	Moderate: slope, seepage.	Slight----------	Deep to water	Slope, erodes easily.	Favorable-------	Erodes easily.
471--------------- Oran	Moderate: seepage.	Moderate: piping, wetness.	Frost action---	Wetness---------	Wetness---------	Favorable.
478G*: Rock outcrop.						
Nordness----------	Severe: slope, depth to rock.	Severe: thin layer.	Deep to water	Droughty, slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, droughty.
480B, 480C-------- Orwood	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope-----------	Erodes easily	Erodes easily.
480D2, 480E2------ Orwood	Severe: slope.	Moderate: piping.	Deep to water	Slope-----------	Slope, erodes easily.	Slope, erodes easily.
483C-------------- Frankville	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
483D2, 483E2: Frankville	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
485: Spillville	Moderate: seepage.	Moderate: piping, wetness.	Deep to water	Flooding	Favorable	Favorable.
487B*:						
Otter	Moderate: seepage.	Severe: ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Ponding	Wetness.
Worthen	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
489: Ossian	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
490: Caneek	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
496B*:						
Dorchester	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.
Volney	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, rooting depth, slope.	Large stones	Large stones, rooting depth.
497E*, 497F*:						
Fayette	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope	Slope, erodes easily.
Dubuque	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
499B: Nordness	Severe: depth to rock.	Severe: thin layer.	Deep to water	Droughty, slope, depth to rock.	Depth to rock, erodes easily.	Droughty, erodes easily.
499D, 499F: Nordness	Severe: slope, depth to rock.	Severe: thin layer.	Deep to water	Droughty, slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, droughty.
512B: Marlean	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones	Large stones	Large stones.
512D2: Marlean	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones	Slope, large stones.	Large stones, slope.
551: Calamine	Moderate: depth to rock.	Severe: thin layer, ponding.	Ponding, percs slowly, depth to rock.	Ponding, percs slowly, depth to rock.	Depth to rock, erodes easily.	Wetness, erodes easily.
589, 589+: Otter	Moderate: seepage.	Severe: ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Ponding	Wetness.
612D2, 612E2: Mottland	Severe: seepage, slope.	Moderate: seepage, piping, large stones.	Deep to water	Rooting depth, slope, large stones.	Slope, large stones.	Slope, rooting depth, large stones.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
714B, 714C: Winneshiek	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock	Depth to rock.
763D2, 763D3, 763E2, 763E3, 763F2, 763F3: Exette	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
776B, 776C: Lilah	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, rooting depth.	Too sandy, soil blowing.	Droughty, rooting depth.
777: Wapsie	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth	Too sandy	Rooting depth.
777B: Wapsie	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth, slope.	Too sandy	Rooting depth.
793: Bertrand	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
826: Rowley	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
863B: Fayette	Moderate: slope, seepage.	Slight	Deep to water	Slope, erodes easily.	Favorable	Erodes easily.
863D: Fayette	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope	Slope, erodes easily.
902C: Luana	Severe: seepage.	Moderate: seepage.	Deep to water	Percs slowly, rooting depth, slope.	Large stones, erodes easily.	Erodes easily, rooting depth.
902D2: Luana	Severe: seepage, slope.	Moderate: seepage.	Deep to water	Percs slowly, rooting depth, slope.	Slope, large stones, erodes easily.	Slope, erodes easily, rooting depth.
926: Canoe	Moderate: seepage.	Moderate: piping, wetness.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
930, 930B: Orion	Moderate: seepage.	Severe: wetness, piping.	Flooding, frost action.	Flooding, wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
951F: Medary Variant	Severe: seepage, slope.	Severe: piping.	Deep to water	Percs slowly, slope, erodes easily.	Slope, erodes easily, too sandy.	Slope, erodes easily, percs slowly.
977: Richwood	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
978: Festina	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
981B: Worthen	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
1158: Dorchester	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1212----------------- Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Deep to water	Flooding--------	Favorable-------	Favorable.
1219----------------- Canoe Variant	Moderate: seepage.	Severe: thin layer.	Frost action---	Wetness---------	Wetness---------	Favorable.
1490----------------- Caneek	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
5010*, 5030*. Pits						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
40--------------- Fayette	0-17	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	17-48	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	48-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
41B, 41C--------- Sparta	0-29	Loamy fine sand	SM	A-2, A-4	0	85-100	85-100	50-95	15-50	---	NP
	29-60	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	85-100	85-100	50-95	5-50	---	NP
63B, 63C, 63E---- Chelsea	0-4	Loamy fine sand	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
	4-60	Fine sand, sand, loamy fine sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
65D2, 65F2, 65F3- Lindley	0-6	Loam-------------	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	50-65	15-30	5-15
	6-37	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	15-25
	37-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	30-40	15-25
83B-------------- Kenyon	0-11	Loam-------------	CL	A-6	0	100	95-100	85-95	65-75	30-40	10-20
	11-50	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-95	80-90	50-65	30-40	10-20
	50-60	Loam-------------	CL	A-6	0-5	90-95	85-95	80-90	50-65	25-35	10-20
84--------------- Clyde	0-23	Clay loam, silty clay loam.	OL, MH, ML, OH	A-7	0-5	95-100	95-100	80-90	55-75	45-60	15-25
	23-34	Clay loam, loam, silty clay loam.	CL, ML	A-6, A-7	0-5	95-100	90-95	75-90	50-75	30-50	10-20
	34-39	Sandy loam, loam	SM, SM-SC	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	39-60	Loam-------------	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
98--------------- Huntsville	0-60	Silt loam--------	CL, ML	A-6	0	100	98-100	90-100	80-100	25-40	10-25
109B, 109C, 109D- Backbone	0-8	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	100	75-85	15-40	15-25	5-10
	8-22	Fine sandy loam	SC, SM-SC	A-2, A-4	0-2	90-95	90-95	65-80	20-40	15-25	5-10
	22-27	Clay loam, clay, sandy clay loam.	CL, CH	A-6, A-7	2-5	90-95	90-95	70-80	50-75	35-55	20-30
	27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
110, 110B, 110C-- Lamont	0-7	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	100	80-95	25-50	15-25	5-10
	7-43	Fine sandy loam, sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	100	80-95	15-50	<25	NP-5
	43-60	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	70-90	5-25	---	NP
120B, 120C------- Tama	0-19	Silt loam--------	ML	A-6, A-7	0	100	100	100	95-100	35-50	10-20
	19-34	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	34-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
129B*: Arenzville------	0-28	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	95-100	80-90	25-35	5-10
	28-45	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	85-95	20-45	5-20
	45-60	Stratified silt loam to sand.	CL, CL-ML	A-4	0	75-100	70-95	65-95	50-85	20-30	5-10
Chaseburg-------	0-43	Silt loam--------	ML, CL-ML	A-4	0	100	100	90-100	85-100	<25	NP-5
	43-60	Silt loam--------	ML, CL-ML	A-4	0	100	100	90-100	85-100	<25	NP-5
133-------------- Colo	0-50	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	50-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
136---------------- Ankeny	0-36	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0-5	95-100	95-100	75-90	30-50	<25	2-10
	36-60	Loamy fine sand, fine sandy loam, fine sand.	SM, SC, SM-SC, SW-SM	A-4, A-2, A-3	0-5	95-100	95-100	50-75	5-40	<25	NP-10
142---------------- Chaseburg	0-43	Silt loam----------	ML, CL-ML	A-4	0	100	100	90-100	85-100	<25	NP-5
	43-60	Silt loam----------	ML, CL-ML	A-4	0	100	100	90-100	85-100	<25	NP-5
158---------------- Dorchester	0-31	Silt loam----------	ML, CL-ML, CL	A-4	0	100	100	95-100	90-95	25-35	5-10
	31-60	Silt loam----------	OL, ML, CL	A-6, A-7	0	100	100	95-100	90-95	35-45	10-20
162B, 162C-------- Downs	0-12	Silt loam----------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	12-39	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	39-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
162C2-------------- Downs	0-8	Silt loam----------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	8-44	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	44-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
162D--------------- Downs	0-8	Silt loam----------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	8-44	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	44-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
162D2, 162E2------ Downs	0-8	Silt loam----------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	8-40	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	40-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
163B, 163C, 163C2, 163D, 163D2------------ Fayette	0-9	Silt loam----------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	9-48	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	48-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
163D3-------------- Fayette	0-8	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	8-40	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	40-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
163E, 163E2------- Fayette	0-9	Silt loam----------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	9-48	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	48-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
163E3-------------- Fayette	0-8	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	8-40	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	40-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
163F, 163F2------- Fayette	0-9	Silt loam----------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	9-48	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	48-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
163F3-------------- Fayette	0-8	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	8-40	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	40-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20
163G--------------- Fayette	0-8	Silt loam----------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	8-48	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	48-60	Silt loam----------	CL	A-6	0	100	100	100	95-100	30-40	10-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
171B, 171C2------ Bassett	0-14	Loam-------------	CL, CL-ML	A-4, A-6	0	100	95-100	85-95	65-85	20-30	5-15
	14-60	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	11-20
177, 177B-------- Saude	0-17	Loam-------------	CL	A-6	0	100	90-100	70-90	50-75	25-35	10-15
	17-29	Loam, sandy loam	CL, SC, CL-ML, SM-SC	A-4, A-6	0-5	85-95	80-95	70-85	36-60	20-30	5-15
	29-60	Gravelly loamy sand, gravelly coarse sand, sand.	SW, SM, GP, GM	A-1	2-10	50-90	50-85	20-40	3-25	---	NP
178-------------- Waukee	0-17	Loam-------------	CL	A-6	0	100	90-100	70-90	50-75	30-40	10-20
	17-38	Loam, sandy clay loam.	CL, SM-SC, SC, CL-ML	A-6, A-4	0-5	85-95	80-95	65-85	40-60	20-35	5-15
	38-60	Gravelly sand, loamy coarse sand, sand.	SW, SM, SP-SM, SP	A-1	2-10	60-90	60-85	20-40	3-25	---	NP
183C, 183D, 183D2, 183E, 183E2----------- Dubuque	0-9	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	9-21	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	21-26	Clay, silty clay	CH	A-7	2-10	85-95	80-90	70-85	65-85	50-70	30-45
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
183E3------------ Dubuque	0-7	Silty clay loam	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	7-22	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	22-25	Clay, silty clay	CH	A-7	2-10	85-95	80-90	70-85	65-85	50-70	30-45
	25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
183F------------- Dubuque	0-9	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	9-20	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	20-23	Clay, silty clay	CH	A-7	2-10	85-95	80-90	70-85	65-85	50-70	30-45
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
196C------------- Volney	0-29	Channery silt loam, flaggy silt loam.	CL, SC, GC, GM-GC	A-4, A-6	20-30	60-80	60-70	55-65	40-60	25-35	5-15
	29-60	Channery silt loam, channery loam, very channery silt loam, flaggy silt loam.	GW-GC, GW, GP, GP-GM	A-1, A-2	50-75	10-40	10-30	10-20	3-12	20-30	3-10
213B------------- Rockton	0-17	Loam-------------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	17-30	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	90-100	75-90	45-70	30-45	10-20
	30-33	Clay, clay loam, silty clay.	CH, CL	A-7	0-2	90-100	90-100	90-95	70-90	40-60	20-35
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
214B------------- Rockton	0-13	Loam-------------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	13-22	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	90-100	75-90	45-70	30-45	10-20
	22-25	Clay, clay loam, silty clay.	CH, CL	A-7	0-2	90-100	90-100	90-95	70-90	40-60	20-35
	25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
215E----------- Goss	0-12	Loam, cherty fine sandy loam.	SM, SM-SC CL-ML	A-2	0-10	65-90	65-90	50-80	15-35	15-20	NP-5
	12-60	Cherty silty clay loam, cherty silty clay, cherty clay.	GC	A-7	10-45	45-70	40-65	40-50	35-45	50-70	30-40
221B----------- Palms	0-24	Sapric material	Pt	---	---	---	---	---	---	---	---
	24-60	Clay loam, silty clay loam, fine sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
225------------ Lawler	0-15	Loam------------	CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	15-28	Loam, sandy loam, clay loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	28-60	Stratified sandy loam to gravelly coarse sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
226------------ Lawler	0-20	Loam------------	CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	20-38	Loam, sandy loam, clay loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	38-60	Stratified sandy loam to gravelly coarse sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
249, 249C-------- Zwingle	0-10	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	10-48	Silty clay, silty clay loam, clay.	CH	A-7	0	100	100	100	95-100	55-70	30-40
	48-60	Clay, silty clay loam.	CH	A-7, A-6	0	100	100	100	95-100	55-70	30-40
284, 284B-------- Flagler	0-19	Sandy loam-------	SC, SM-SC	A-2, A-4	0	95-100	90-95	60-70	25-40	15-25	5-10
	19-33	Sandy loam-------	SC, SM-SC	A-2, A-4	0	95-100	90-95	50-70	25-40	15-25	5-10
	33-60	Loamy sand, gravelly sand.	SP-SM, SW, SP, SW-SM	A-1	0-5	70-90	70-85	20-40	3-12	---	NP
291------------ Atterberry	0-12	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	12-46	Silty clay loam, silt loam.	CL, CH	A-7, A-6	0	100	100	95-100	95-100	35-55	20-30
	46-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
320------------ Arenzville	0-28	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	95-100	80-90	25-35	5-10
	28-45	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	85-95	20-45	5-20
	45-60	Stratified silt loam to sand.	CL, CL-ML	A-4	0	75-100	70-95	65-95	50-85	20-30	5-10
323B----------- Terril	0-27	Loam------------	CL	A-4, A-6	0-5	100	95-100	70-90	60-80	25-40	8-15
	27-49	Loam, clay loam	CL	A-4, A-6	0-5	100	90-100	70-90	60-80	25-40	8-15
	49-60	Sand, gravelly sand, loamy sand	SP-SM, SM	A-2-4	0-25	90-100	75-90	60-80	10-35	---	NP
391B*:											
Clyde----------	0-23	Clay loam, silty clay loam.	OL, MH, ML, OH	A-7	0-5	95-100	95-100	80-90	55-75	45-60	15-25
	23-34	Clay loam, loam, silty clay loam.	CL, ML	A-6, A-7	0-5	95-100	90-95	75-90	50-75	30-50	10-20
	34-39	Sandy loam, loam	SM, SM-SC	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	39-60	Loam------------	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
Floyd----------	0-15	Loam------------	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
	15-25	Sandy clay loam, loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	25-33	Sandy loam, loamy sand.	SM, SM-SC	A-2	2-5	90-95	70-80	50-70	15-35	10-20	NP-5
	33-60	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
408B, 408C-------- Olin	0-28	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	95-100	85-95	30-50	20-30	5-10
	28-54	Loam, clay loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-95	80-90	45-65	25-35	10-20
	54-60	Loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	80-90	50-65	25-35	10-20
444B, 444C, 444D- Jacwin	0-18	Loam-------------	OL, ML	A-7	0	100	100	90-95	50-65	40-50	10-20
	18-24	Loam, sandy clay loam, clay loam.	CL, SC	A-6	2-5	95-100	90-95	85-95	45-65	25-35	10-20
	24-35	Silty clay, clay	CL, CH	A-7	0	100	100	95-100	80-95	40-55	20-30
	35-60	Silty clay shale	---	---	---	---	---	---	---	---	---
462B------------- Downs	0-17	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	17-39	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	39-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
463B, 463C-------- Fayette	0-17	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	17-48	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	48-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
471-------------- Oran	0-20	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	85-95	55-75	25-35	5-15
	20-41	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	10-20
	41-60	Loam-------------	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	10-20
478G*: Rock outcrop.											
Nordness---------	0-6	Silt loam--------	CL, CL-ML	A-4	0	100	100	90-100	70-90	20-30	5-10
	6-11	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	90-100	70-90	35-45	15-25
	11-16	Silty clay loam, silty clay, clay.	CL, CH	A-7	2-10	85-95	80-90	70-85	65-85	45-60	30-40
	16	Unweathered bedrock, weathered bedrock.	---	---	---	---	---	---	---	---	---
480B, 480C, 480D2, 480E2---- Orwood	0-8	Silt loam--------	CL	A-4, A-6	0	100	100	90-100	80-90	30-40	8-15
	8-56	Silt loam, loam, clay loam.	CL	A-6	0	100	100	85-95	60-80	30-40	10-20
	56-60	Silt loam, loam	CL	A-6	0	100	100	85-95	70-90	30-40	10-20
483C, 483D2, 483E2----------- Frankville	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	12-26	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	26-28	Clay, silty clay	CH	A-7	2-10	85-95	80-90	70-85	65-80	50-70	30-45
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
485-------------- Spillville	0-48	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	48-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
487B*: Otter-----------	0-31	Silt loam--------	CL	A-6, A-7	0	100	98-100	90-100	80-100	30-45	10-20
	31-60	Stratified silt loam to sandy loam.	CL, ML, SM, SC	A-4, A-6	0	90-100	80-100	55-95	45-85	20-40	3-20
Worthen---------	0-60	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	80-100	25-40	7-21

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
489-------------- Ossian	0-15	Silt loam---------	ML, CL, OL	A-6, A-7	0	100	100	100	95-100	35-50	10-25
	15-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	100	95-100	30-40	10-20
490-------------- Caneek	0-32	Silt loam---------	ML, CL-ML, CL	A-4	0	100	100	95-100	90-95	25-35	5-10
	32-60	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	90-95	35-45	10-20
496B*:											
Dorchester-------	0-31	Silt loam---------	ML, CL-ML, CL	A-4	0	100	100	95-100	90-95	25-35	5-10
	31-60	Silt loam---------	OL, ML, CL	A-6, A-7	0	100	100	95-100	90-95	35-45	10-20
Volney-----------	0-29	Channery silt loam, flaggy silt loam.	CL, SC, GC, GM-GC	A-4, A-6	20-30	60-80	60-70	55-65	40-60	25-35	5-15
	29-60	Channery silt loam, channery loam, flaggy silt loam.	GW-GC, GW, GP, GP-GM	A-1, A-2	50-75	10-40	10-30	10-20	3-12	20-30	3-10
497E*, 497F*:											
Fayette----------	0-17	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	17-48	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	48-60	Silt loam---------	CL	A-6	0	100	100	100	95-100	30-40	10-20
Dubuque----------	0-9	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	9-21	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	21-26	Clay, silty clay	CH	A-7	2-10	85-95	80-90	70-85	65-85	50-70	30-45
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
499B, 499D, 499F- Nordness	0-6	Silt loam---------	CL, CL-ML	A-4	0	100	100	90-100	70-90	20-30	5-10
	6-11	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	90-100	70-90	35-45	15-25
	11-16	Silty clay loam, silty clay, clay.	CL, CH	A-7	2-10	85-95	80-90	70-85	65-85	45-60	30-40
	16	Unweathered bedrock, weathered bedrock.	---	---	---	---	---	---	---	---	---
512B, 512D2------ Marlean	0-8	Loam--------------	CL, CL-ML	A-4, A-6	5-15	75-95	70-90	60-85	50-85	20-30	5-15
	8-12	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	0-10	85-95	80-90	70-85	50-85	35-45	15-20
	12-60	Flaggy loam, flaggy clay loam, flaggy sandy clay loam.	SM, SC, GM, GC	A-4, A-2, A-1	20-50	30-70	30-70	25-50	12-40	<20	NP-10
551-------------- Calamine	0-15	Loam--------------	CL, CL-ML	A-4	0	100	100	85-100	65-90	20-30	5-10
	15-27	Clay loam, silt loam.	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
	27-36	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-60	25-35
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
589-------------- Otter	0-31	Silt loam---------	CL	A-6, A-7	0	100	98-100	90-100	80-100	30-45	10-20
	31-60	Stratified silt loam to sandy loam.	CL, ML, SM, SC	A-4, A-6	0	90-100	80-100	55-95	45-85	20-40	3-20
589+------------- Otter	0-18	Silt loam---------	CL	A-6, A-7	0	100	98-100	90-100	80-100	30-45	10-20
	18-60	Stratified silt loam to sandy loam.	CL, ML, SM, SC	A-4, A-6	0	90-100	80-100	55-95	45-85	20-40	3-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
612D2, 612E2----- Mottland	0-9	Silt loam--------	CL, CL-ML	A-6, A-4	3-10	90-95	75-85	70-80	55-65	25-40	5-15
	9-60	Channery fine sandy loam, channery sandy loam, channery loam.	SM, SC, SM-SC	A-2	15-35	80-90	75-85	50-60	20-30	<20	2-8
714B, 714C------- Winneshiek	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0	100	95-100	85-95	55-70	20-30	5-15
	8-22	Loam, clay loam	CL	A-6	2-5	90-95	80-95	80-90	50-65	25-40	11-20
	22-27	Clay, silty clay	CH	A-7	2-10	85-95	80-95	80-90	70-90	55-70	30-45
	27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
763D2, 763D3, 763E2, 763E3, 763F2, 763F3---- Exette	0-6	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	100	95-100	25-35	5-10
	6-38	Silt loam--------	ML, CL	A-6, A-4	0	100	100	100	95-100	30-40	7-15
	38-60	Silt loam--------	CL, ML	A-4, A-6	0	100	100	100	95-100	30-40	7-15
776B, 776C------- Lilah	0-11	Sandy loam-------	SM-SC, SC	A-2, A-4	0-5	90-95	80-90	60-70	25-40	15-25	5-10
	11-40	Gravelly sandy loam, gravelly loamy sand, sand.	SW, SW-SM, SP, SP-SM	A-1-b	0-10	70-80	50-70	30-50	3-12	---	NP
	40-60	Loamy sand, gravelly loamy sand, sand.	GP, SP, GP-GM, SP-SM	A-1-b	0-10	50-60	40-50	30-50	3-12	---	NP
777, 777B-------- Wapsie	0-8	Loam-------------	CL, ML, CL-ML	A-4	0	100	90-100	70-90	50-75	25-35	5-10
	8-29	Loam, sandy loam	CL, SC, CL-ML, SM-SC	A-4, A-6	0	85-95	80-95	70-85	40-60	20-35	5-15
	29-60	Gravelly loamy sand, gravelly sand.	SW, SM, SP, SP-SM	A-1	0	60-90	60-85	20-40	3-25	---	NP
793-------------- Bertrand	0-17	Silt loam--------	ML	A-4	0	100	100	90-100	80-90	25-35	3-10
	17-52	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	90-100	80-95	25-40	7-20
	52-60	Stratified silt loam to loamy sand.	ML, SM, CL, SC	A-4	0	100	100	80-95	35-75	<25	2-10
826-------------- Rowley	0-19	Silt loam--------	CL	A-4, A-6	0	100	100	90-100	70-95	25-35	8-13
	19-49	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	30-50	10-25
	49-60	Stratified silt loam to sand.	CL, CL-ML, SC, SM-SC	A-4, A-6	0	100	100	80-100	35-75	20-30	4-11
863B, 863D------- Fayette	0-17	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	17-48	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	48-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
902C, 902D2------ Luana	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	9-23	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	23-27	Silty clay loam, silty clay.	CH	A-7	0	100	95-100	70-90	65-85	50-65	30-40
	27-60	Channery fine sandy loam, channery sandy loam, flaggy sandy loam.	SM, SC, SM-SC	A-2	10-35	70-80	65-75	50-60	25-35	<20	2-8

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
926---------------- Canoe	0-8	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	8-47	Silt loam---------	CL-ML, CL	A-4	0	100	100	100	95-100	20-30	5-10
	47-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	100	95-100	30-40	10-20
930, 930B--------- Orion	0-29	Silt loam---------	CL, CL-ML	A-4	0	100	100	85-100	80-100	20-30	4-10
	29-60	Stratified silt loam to very fine sand.	CL, CL-ML	A-4	0	100	100	90-100	70-80	20-30	4-10
951F-------------- Medary Variant	0-5	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	5-31	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	95-100	55-70	30-40
	31-60	Stratified silt loam to fine sand.	CL, SC, CL-ML, SM-SC	A-4	0	100	90-95	60-95	40-80	20-30	5-10
977--------------- Richwood	0-20	Silt loam---------	ML	A-4	0	100	100	90-100	85-95	25-35	3-10
	20-52	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	85-95	20-35	5-15
	52-60	Fine sand, sandy loam.	SM, SP-SM	A-2, A-3	0	100	100	50-80	5-35	---	NP
978--------------- Festina	0-13	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	13-43	Silt loam, silty clay loam.	CL	A-6	0	100	100	100	95-100	30-40	10-20
	43-60	Stratified silt loam to loamy sand.	SM, SC, ML, CL	A-2, A-4	0	100	100	70-90	15-70	15-30	NP-10
981B-------------- Worthen	0-60	Silt loam---------	CL	A-4, A-6	0	100	100	95-100	80-100	25-40	7-21
1158-------------- Dorchester	0-31	Silt loam---------	ML, CL-ML, CL	A-4	0	100	100	95-100	90-95	25-35	5-10
	31-60	Silt loam---------	OL, ML, CL	A-6, A-7	0	100	100	95-100	90-95	35-45	10-20
1212-------------- Kennebec	0-31	Silt loam---------	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	31-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
1219-------------- Canoe Variant	0-15	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	15-43	Silt loam---------	CL	A-6	0	100	100	100	95-100	25-35	10-20
	43-60	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
1490-------------- Caneek	0-32	Silt loam---------	ML, CL-ML, CL	A-4	0	100	100	95-100	90-95	25-35	5-10
	32-60	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	90-95	35-45	10-20
5010*, 5030*. Pits											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
40----------------	0-17	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.37	5	6	1-2
Fayette	17-48	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate------	0.37			
	48-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate------	0.37			
41B, 41C----------	0-29	3-10	1.20-1.40	2.0-6.0	0.09-0.12	5.1-7.3	Low-----------	0.17	5	2	1-2
Sparta	29-60	1-8	1.40-1.60	6.0-20	0.05-0.11	5.1-6.5	Low-----------	0.17			
63B, 63C, 63E-----	0-4	8-15	1.50-1.55	6.0-20	0.10-0.15	5.6-7.3	Low-----------	0.17	5	2	.5-1
Chelsea	4-60	5-10	1.55-1.70	6.0-20	0.06-0.08	5.1-6.5	Low-----------	0.17			
65D2, 65F2, 65F3-	0-6	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low-----------	0.32	5	6	<.5
Lindley	6-37	25-35	1.35-1.55	0.2-0.6	0.14-0.18	4.5-6.5	Moderate------	0.32			
	37-60	18-32	1.40-1.60	0.2-0.6	0.12-0.16	6.1-7.8	Moderate------	0.32			
83B---------------	0-11	20-25	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28	5	6	3-4
Kenyon	11-50	20-30	1.45-1.65	0.6-2.0	0.17-0.19	5.1-7.3	Low-----------	0.28			
	50-60	20-24	1.65-1.80	0.6-2.0	0.17-0.19	6.6-7.8	Low-----------	0.37			
84----------------	0-23	28-32	1.35-1.40	0.6-2.0	0.21-0.23	6.1-7.3	Moderate------	0.28	5	7	7-11
Clyde	23-34	22-28	1.45-1.65	0.6-2.0	0.18-0.20	6.1-7.3	Moderate------	0.37			
	34-39	10-15	1.60-1.70	2.0-6.0	0.11-0.13	6.1-7.3	Low-----------	0.37			
	39-60	20-24	1.70-1.80	0.6-2.0	0.17-0.19	6.1-8.4	Moderate------	0.37			
98----------------	0-60	18-27	1.15-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Moderate------	0.28	5	6	3-4
Huntsville											
109B, 109C, 109D-	0-8	8-18	1.50-1.55	2.0-6.0	0.12-0.14	5.6-7.3	Low-----------	0.24	4	3	1-2
Backbone	8-22	12-18	1.55-1.65	2.0-6.0	0.11-0.13	5.1-7.3	Low-----------	0.24			
	22-27	36-42	1.65-1.80	0.2-0.6	0.14-0.16	5.6-7.3	High----------	0.24			
	27	---	---	---	---	---	--------------	----			
110, 110B, 110C--	0-7	10-15	1.50-1.55	2.0-6.0	0.16-0.18	5.1-7.3	Low-----------	0.24	5	3	.5-1
Lamont	7-43	5-15	1.50-1.55	2.0-6.0	0.14-0.16	5.1-7.3	Low-----------	0.24			
	43-60	2-10	1.65-1.75	6.0-20	0.09-0.11	5.1-6.5	Low-----------	0.17			
120B, 120C--------	0-19	24-29	1.25-1.30	0.6-2.0	0.22-0.24	5.1-7.3	Moderate------	0.32	5	7	3-4
Tama	19-34	28-34	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate------	0.43			
	34-60	22-28	1.35-1.40	0.6-2.0	0.18-0.20	5.1-7.3	Moderate------	0.43			
129B*:											
Arenzville-------	0-28	10-18	1.20-1.55	0.6-2.0	0.20-0.24	5.6-7.8	Low-----------	0.37	5	5	.5-1
	28-45	10-30	1.25-1.45	0.6-2.0	0.18-0.22	5.6-7.8	Moderate------	0.37			
	45-60	5-20	1.20-1.40	0.6-2.0	0.12-0.16	5.6-7.8	Low-----------	0.37			
Chaseburg--------	0-4	12-16	1.35-1.55	0.6-2.0	0.22-0.24	6.1-7.3	Low-----------	0.37	5	5	.5-1
	43-60	10-18	1.55-1.65	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.37			
133---------------	0-50	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High----------	0.28	5	7	5-7
Colo	50-60	30-35	1.25-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High----------	0.28			
136---------------	0-36	10-18	1.50-1.55	6.0-20	0.16-0.18	6.1-7.3	Low-----------	0.20	5	3	2-3
Ankeny	36-60	2-10	1.65-1.75	6.0-20	0.12-0.14	6.1-7.3	Low-----------	0.20			
142---------------	0-43	12-16	1.35-1.55	0.6-2.0	0.22-0.24	6.1-7.3	Low-----------	0.37	5	5	.5-1
Chaseburg	43-60	10-18	1.55-1.65	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.37			
158---------------	0-31	18-24	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low-----------	0.37	5	6	.5-1
Dorchester	31-60	18-26	1.25-1.40	0.6-2.0	0.22-0.24	6.6-7.3	Moderate------	0.37			
162B, 162C--------	0-12	18-24	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Low-----------	0.32	5	6	2-3
Downs	12-39	26-34	1.30-1.35	0.6-2.0	0.18-0.20	4.5-6.0	Moderate------	0.43			
	39-60	22-26	1.35-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate------	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
162C2, 162D, 162D2, 162E2---- Downs	0-8	18-24	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Low-----------	0.32	5	6	1-3
	8-44	26-34	1.30-1.35	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.43			
	44-60	22-26	1.35-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
163B, 163C, 163C2, 163D,, 163D2---------- Fayette	0-9	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.37	5	6	.5-2
	9-48	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	48-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate-----	0.37			
163D3------------ Fayette	0-8	28-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37	4	7	0-.5
	8-40	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	40-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate-----	0.37			
163E, 163E2------ Fayette	0-9	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.37	5	6	.5-2
	9-48	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	48-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate-----	0.37			
163E3------------ Fayette	0-8	28-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37	4	7	<.5
	8-40	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	40-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate-----	0.37			
163F, 163F2------ Fayette	0-9	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.37	5	6	.5-2
	9-48	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	48-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate-----	0.37			
163F3------------ Fayette	0-8	28-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37	4	7	0-.5
	8-40	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	40-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate-----	0.37			
163G------------- Fayette	0-9	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.37	5	6	1-2
	9-48	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	48-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate-----	0.37			
171B, 171C2------ Bassett	0-14	18-25	1.45-1.50	0.6-2.0	0.19-0.21	5.1-6.5	Low-----------	0.28	5	6	1-3
	14-60	20-28	1.55-1.65	0.6-2.0	0.17-0.19	4.5-5.5	Low-----------	0.28			
177, 177B-------- Saude	0-17	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28	4	5	3-4
	17-29	12-20	1.40-1.50	0.6-6.0	0.15-0.19	5.1-6.0	Low-----------	0.28			
	29-60	2-8	1.50-1.75	>20	0.02-0.06	5.1-6.5	Very low-----	0.10			
178-------------- Waukee	0-17	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.24	4	6	3-4
	17-38	20-26	1.40-1.50	0.6-2.0	0.15-0.19	4.5-6.5	Low-----------	0.32			
	38-60	2-8	1.50-1.75	>20	0.02-0.06	5.6-7.3	Low-----------	0.10			
183C, 183D, 183D2, 183E, 183E2, 183E3, 183F------------ Dubuque	0-9	18-25	1.30-1.35	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.37	4-3	6	<2
	9-21	26-35	1.30-1.45	0.6-2.0	0.18-0.20	5.6-6.0	Moderate-----	0.37			
	21-26	40-55	1.50-1.70	0.06-0.2	0.12-0.15	5.6-6.0	Moderate-----	0.37			
	26	---	---	---	---	---	-------------	----			
196C------------- Volney	0-29	18-24	1.40-1.55	2.0-6.0	0.13-0.16	7.4-8.4	Low-----------	0.24	2	6	3-5
	29-60	12-25	1.70-1.90	>20	0.02-0.04	7.4-8.4	Low-----------	----			
213B------------- Rockton	0-17	18-28	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low-----------	0.28	4	6	2-4
	17-30	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Moderate-----	0.28			
	30-33	35-60	1.35-1.45	0.6-2.0	0.10-0.14	5.6-7.3	High----------	0.28			
	33	---	---	---	---	---	-------------	----			
214B------------- Rockton	0-13	18-28	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low-----------	0.28	4	6	2-4
	13-22	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Moderate-----	0.28			
	22-25	35-60	1.35-1.45	0.6-2.0	0.10-0.14	5.6-7.3	High----------	0.28			
	25	---	---	---	---	---	-------------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
215E-------------- Goss	0-12	7-27	1.10-1.30	2.0-6.0	0.06-0.17	4.5-6.5	Low-----------	0.24	2	6	.5-1
	12-60	35-60	1.30-1.50	0.6-2.0	0.04-0.09	4.5-6.0	Moderate------	0.24			
221B-------------- Palms	0-24	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	--------------	----	2	3	30-45
	24-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low-----------	----			
225--------------- Lawler	0-15	18-28	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28	4	6	4-5
	15-28	20-28	1.45-1.60	0.6-2.0	0.16-0.18	5.1-6.5	Low-----------	0.28			
	28-60	2-12	1.60-1.75	>20	0.02-0.04	5.1-6.5	Low-----------	0.10			
226--------------- Lawler	0-20	18-28	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28	4	6	4-5
	20-38	20-28	1.45-1.60	0.6-2.0	0.16-0.18	5.1-6.5	Low-----------	0.28			
	38-60	2-12	1.60-1.75	>20	0.02-0.04	5.1-6.5	Low-----------	0.10			
249, 249C--------- Zwingle	0-10	18-35	1.25-1.30	0.2-0.6	0.20-0.22	4.5-7.3	Low-----------	0.43	3	6	1-2
	10-48	38-60	1.30-1.45	<0.06	0.12-0.16	4.5-6.5	High----------	0.43			
	48-60	38-60	1.45-1.60	<0.06	0.12-0.16	6.1-7.8	High----------	0.43			
284, 284B--------- Flagler	0-19	12-18	1.50-1.55	2.0-6.0	0.12-0.14	5.1-7.3	Low-----------	0.20	4	3	1-2
	19-33	10-15	1.55-1.60	2.0-6.0	0.11-0.13	5.1-6.5	Low-----------	0.20			
	33-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low-----------	0.20			
291--------------- Atterberry	0-12	20-26	1.20-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	5	6	2-4
	12-46	25-35	1.30-1.50	0.6-2.0	0.18-0.20	5.1-6.0	Moderate------	0.43			
	46-60	20-30	1.35-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.43			
320--------------- Arenzville	0-28	10-18	1.20-1.55	0.6-2.0	0.20-0.24	5.6-7.8	Low-----------	0.37	5	5	.5-1
	28-45	10-30	1.25-1.45	0.6-2.0	0.18-0.22	5.6-7.8	Moderate------	0.37			
	45-60	5-20	1.20-1.40	0.6-2.0	0.12-0.16	5.6-7.8	Low-----------	0.37			
323B-------------- Terril	0-27	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.32	5	6	4-5
	27-49	22-30	1.40-1.65	0.6-2.0	0.16-0.18	6.6-7.3	Low-----------	0.32			
	49-60	2-8	1.65-1.75	6.0-20	0.05-0.07	6.1-8.4	Low-----------	0.10			
391B*:											
Clyde------------	0-23	28-32	1.35-1.40	0.6-2.0	0.21-0.23	6.1-7.3	Moderate------	0.28	5	7	7-11
	23-34	22-28	1.45-1.65	0.6-2.0	0.18-0.20	6.1-7.3	Moderate------	0.37			
	34-39	10-15	1.60-1.70	2.0-6.0	0.11-0.13	6.1-7.3	Low-----------	0.37			
	39-60	20-24	1.70-1.80	0.6-2.0	0.17-0.19	6.1-8.4	Moderate------	0.37			
Floyd------------	0-15	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.24	5	6	5-7
	15-25	18-24	1.40-1.60	0.6-2.0	0.16-0.18	6.1-7.3	Low-----------	0.32			
	25-33	6-12	1.60-1.65	2.0-6.0	0.11-0.13	6.1-7.3	Low-----------	0.32			
	33-60	18-30	1.65-1.80	0.6-2.0	0.16-0.18	6.1-7.8	Low-----------	0.32			
408B, 408C-------- Olin	0-28	12-18	1.45-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low-----------	0.20	5	3	1-2
	28-54	20-28	1.50-1.70	0.6-2.0	0.17-0.19	5.6-6.0	Low-----------	0.32			
	54-60	20-28	1.70-1.80	0.6-2.0	0.17-0.19	5.6-6.0	Low-----------	0.32			
444B, 444C, 444D- Jacwin	0-18	22-34	1.35-1.45	0.6-2.0	0.20-0.22	6.6-7.3	Moderate------	0.28	5	6	4-5
	18-24	24-34	1.50-1.60	0.6-2.0	0.17-0.19	6.6-7.3	Low-----------	0.28			
	24-35	40-60	1.70-1.80	<0.06	0.12-0.14	6.6-8.4	Moderate------	0.28			
	35-60	---	1.80-1.90	---	---	---	--------------	----			
462B-------------- Downs	0-17	18-24	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Low-----------	0.32	5	6	2-3
	17-39	26-34	1.30-1.35	0.6-2.0	0.18-0.20	4.5-6.0	Moderate------	0.43			
	39-60	22-26	1.35-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate------	0.43			
463B, 463C-------- Fayette	0-17	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.37	5	6	1-2
	17-48	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate------	0.37			
	48-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate------	0.37			
471--------------- Oran	0-20	16-24	1.40-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Low-----------	0.28	5	6	2-3
	20-41	22-28	1.45-1.70	0.6-2.0	0.17-0.19	5.1-6.5	Low-----------	0.28			
	41-60	20-26	1.45-1.70	0.6-2.0	0.17-0.19	6.1-7.4	Low-----------	0.37			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi-bility group	Organic matter
								K	T		
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
478G*: Rock outcrop.											
Nordness----------	0-6	18-24	1.30-1.35	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.43	2	6	1-2
	6-11	22-29	1.35-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Moderate------	0.43			
	11-16	27-45	1.35-1.60	0.06-0.2	0.12-0.15	6.1-7.3	High----------	0.43			
	16	---	---	---	---	---	--------------	----			
480B, 480C, 480D2, 480E2----- Orwood	0-8	18-24	1.35-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Low-----------	0.32	5	5	1-3
	8-56	22-28	1.40-1.45	0.6-2.0	0.18-0.22	5.1-7.3	Moderate------	0.43			
	56-60	18-26	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate------	0.43			
483C, 483D2, 483E2----------- Frankville	0-12	18-25	1.30-1.35	0.6-2.0	0.21-0.23	6.1-7.3	Moderate------	0.32	4	6	1-3
	12-26	23-32	1.30-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate------	0.43			
	26-28	40-55	1.50-1.70	0.06-0.2	0.12-0.15	6.1-7.3	High----------	0.32			
	28	---	---	---	---	---	--------------	----			
485-------------- Spillville	0-48	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate------	0.28	5	6	4-6
	48-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low-----------	0.28			
487B*: Otter------------	0-31	18-27	1.10-1.25	0.6-2.0	0.22-0.24	6.1-7.8	Low-----------	0.28	5	6	5-7
	31-60	5-20	1.30-1.60	0.6-2.0	0.12-0.21	6.6-8.4	Low-----------	0.28			
Worthen----------	0-60	15-22	1.20-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	5-4	6	3-5
489-------------- Ossian	0-15	22-27	1.25-1.30	0.6-2.0	0.22-0.24	6.6-7.3	Moderate------	0.28	5	6	5-7
	15-60	20-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.8	Moderate------	0.28			
490-------------- Caneek	0-32	16-24	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low-----------	0.37	5	6	.5-1
	32-60	18-28	1.25-1.40	0.6-2.0	0.22-0.24	6.6-7.3	Moderate------	0.37			
496B*: Dorchester-------	0-31	18-24	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low-----------	0.37	5	6	.5-1
	31-60	18-26	1.25-1.40	0.6-2.0	0.22-0.24	6.6-7.3	Moderate------	0.37			
Volney-----------	0-29	18-24	1.40-1.55	2.0-6.0	0.13-0.16	7.4-8.4	Low-----------	0.24	2	6	3-5
	29-60	12-25	1.70-1.90	>20	0.02-0.04	7.4-8.4	Low-----------	----			
497E*, 497F*: Fayette----------	0-17	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.37	5	6	1-2
	17-48	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate------	0.37			
	48-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate------	0.37			
Dubuque----------	0-9	18-25	1.30-1.35	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.37	4-3	6	1-2
	9-21	26-35	1.30-1.45	0.6-2.0	0.18-0.20	5.6-6.0	Moderate------	0.37			
	21-26	40-55	1.50-1.70	0.06-0.2	0.12-0.15	5.6-6.0	Moderate------	0.37			
	26	---	---	---	---	---	--------------	----			
499B, 499D, 499F- Nordness	0-6	18-24	1.30-1.35	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.43	2	6	1-2
	6-11	22-29	1.35-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Moderate------	0.43			
	11-16	27-45	1.35-1.60	0.06-0.2	0.12-0.15	6.1-7.3	High----------	0.43			
	16	---	---	---	---	---	--------------	----			
512B, 512D2------ Marlean	0-8	18-24	1.40-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.24	2	6	1-3
	8-12	18-30	1.40-1.55	0.6-2.0	0.18-0.22	6.1-7.3	Moderate------	0.24			
	12-60	12-28	1.70-1.90	2.0-6.0	0.08-0.15	7.4-7.8	Low-----------	0.24			
551-------------- Calamine	0-15	18-27	1.20-1.35	0.6-2.0	0.20-0.24	6.1-7.8	Low-----------	0.28	5	6	8-10
	15-27	22-35	1.50-1.60	0.06-0.6	0.18-0.20	6.1-7.8	Moderate------	0.28			
	27-36	35-50	1.55-1.65	<0.06	0.08-0.12	6.1-7.8	Moderate------	0.28			
	36-60	---	---	---	---	---	--------------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
589 Otter	0-31	18-27	1.10-1.25	0.6-2.0	0.22-0.24	6.1-7.8	Low	0.28	5	6	5-7
	31-60	5-20	1.30-1.60	0.6-2.0	0.12-0.21	6.6-8.4	Low	0.28			
589+ Otter	0-18	18-27	1.10-1.25	0.6-2.0	0.22-0.24	6.1-7.8	Low	0.28	5	6	1-2
	18-60	5-20	1.30-1.60	0.6-2.0	0.12-0.21	6.6-8.4	Low	0.28			
612D2, 612E2 Mottland	0-9	16-22	1.45-1.55	0.6-2.0	0.16-0.18	6.6-8.4	Low	0.28	2	6	.5-1
	9-60	10-15	1.60-1.90	2.0-6.0	0.08-0.10	7.9-8.4	Low	----			
714B, 714C Winneshiek	0-8	18-24	1.45-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Low	0.28	4	6	2-3
	8-22	20-28	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.3	Low	0.28			
	22-27	40-55	1.70-1.80	0.06-0.2	0.12-0.15	5.6-7.3	High	0.28			
	27	---	---	---	---	---	----------	----			
763D2, 763D3, 763E2, 763E3, 763F2, 763F3 Exette	0-6	18-22	1.30-1.35	0.6-2.0	0.21-0.23	6.6-7.3	Low	0.37	5-4	6	<1
	6-38	22-26	1.35-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	0.37			
	38-60	15-20	1.45-1.50	0.6-2.0	0.20-0.22	6.6-7.8	Moderate	0.37			
776B, 776C Lilah	0-11	8-15	1.50-1.55	6.0-20	0.11-0.13	6.6-7-3	Low	0.20	2	3	<1
	11-40	2-10	1.55-1.80	>20	0.02-0.04	6.1-7.3	Low	0.20			
	40-60	2-6	1.55-1.85	>20	0.02-0.04	4.5-5.5	Low	0.20			
777, 777B Wapsie	0-8	12-18	1.40-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Low	0.28	4	6	1-2
	8-29	12-18	1.45-1.50	0.6-2.0	0.15-0.17	5.6-6.0	Low	0.28			
	29-60	2-10	1.50-1.75	>20.0	0.02-0.06	5.1-7.3	Low	0.10			
793 Bertrand	0-17	15-22	1.35-1.60	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.37	5	5	1-2
	17-52	18-30	1.55-1.65	0.6-2.0	0.18-0.22	5.1-6.5	Moderate	0.37			
	52-60	10-20	1.55-1.65	0.6-6.0	0.09-0.22	5.1-6.5	Low	0.37			
826 Rowley	0-19	15-22	1.35-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Low	0.32	5	5	3-4
	19-49	20-30	1.35-1.65	0.6-2.0	0.18-0.22	5.1-7.3	Low	0.43			
	49-60	10-20	1.55-1.65	0.6-2.0	0.12-0.16	5.1-7.3	Low	0.43			
863B, 863D Fayette	0-17	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low	0.37	5	6	1-2
	17-48	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate	0.37			
	48-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate	0.37			
902C, 902D2 Luana	0-9	20-23	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	4	6	1-3
	9-23	25-31	1.40-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Moderate	0.43			
	23-27	34-45	1.25-1.30	0.06-0.2	0.13-0.16	5.6-7.3	High	0.32			
	27-60	5-12	1.70-1.80	2.0-6.0	0.10-0.12	7.4-8.4	Low	0.20			
926 Canoe	0-8	18-24	1.30-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.28	5	6	2-3
	8-47	20-27	1.35-1.40	0.6-2.0	0.20-0.22	5.1-6.0	Low	0.43			
	47-60	18-30	1.40-1.45	0.6-2.0	0.20-0.22	5.1-6.5	Moderate	0.43			
930, 930B Orion	0-29	10-18	1.20-1.30	0.6-2.0	0.22-0.24	5.6-7.8	Low	0.37	5	5	1-3
	29-60	10-18	1.20-1.30	0.6-2.0	0.20-0.22	5.6-7.8	Low	0.37			
951F Medary Variant	0-5	18-28	1.25-1.30	0.2-0.6	0.20-0.22	4.5-7.3	Low	0.43	3	6	.5-1
	5-31	38-60	1.30-1.45	<0.06	0.12-0.16	4.5-6.5	High	0.43			
	31-60	8-20	1.45-1.60	2.0-6.0	0.08-0.10	6.1-7.8	Low	0.28			
977 Richwood	0-20	15-22	1.35-1.60	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.28	5	5	2-5
	20-52	18-34	1.55-1.65	0.6-2.0	0.18-0.22	5.6-7.3	Moderate	0.43			
	52-60	1-4	1.55-1.65	6.0-20	0.05-0.07	5.6-6.0	Low	0.15			
978 Festina	0-13	18-24	1.30-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.32	5	6	2-3
	13-43	24-29	1.35-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Moderate	0.43			
	43-60	8-18	1.45-1.55	2.0-6.0	0.10-0.18	5.1-5.5	Low	0.43			
981B Worthen	0-60	15-22	1.20-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.32	5-4	6	3-5

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
1158-------------- Dorchester	0-31	18-24	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low-----------	0.37	5	6	.5-1
	31-60	18-26	1.25-1.40	0.6-2.0	0.22-0.24	6.6-7.3	Moderate------	0.37			
1212-------------- Kennebec	0-31	22-30	1.25-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate------	0.32	5	6	4-6
	31-60	24-28	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.43			
1219-------------- Canoe Variant	0-15	18-24	1.30-1.35	0.6-2.0	0.22-0.24	5.6-6.5	Low-----------	0.28	5	6	1-3
	15-43	22-26	1.35-1.40	0.6-2.0	0.20-0.22	5.1-5.5	Moderate------	0.28			
	43-60	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.1-5.5	Low-----------	0.28			
1490-------------- Caneek	0-32	16-24	1.20-1.30	0.6-2.0	0.20-0.22	7.9-8.4	Low-----------	0.37	5	6	.5-1
	32-60	18-28	1.25-1.40	0.6-2.0	0.22-0.24	6.6-7.3	Moderate------	0.37			
5010*, 5030*. Pits											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
40 Fayette	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
41B, 41C Sparta	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
63B, 63C, 63E Chelsea	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
65D2, 65F2, 65F3 Lindley	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
83B Kenyon	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
84 Clyde	B/D	None	---	---	1.0-2.5	Apparent	Nov-Jul	>60	---	High	High	Low.
98 Huntsville	B	Rare	---	---	>6.0	---	---	>60	---	High	Low	Low.
109B, 109C, 109D Backbone	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Low	Low.
110, 110B, 110C Lamont	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
120B, 120C Tama	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
129B*:												
Arenzville	B	Frequent	Brief	Nov-Jun	3.0-6.0	Apparent	Nov-Jun	>60	---	High	Moderate	Moderate.
Chaseburg	B	Frequent	Very brief	Nov-Jun	3.0-6.0	Apparent	Nov-Apr	>60	---	High	Moderate	Moderate.
133 Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
136 Ankeny	B	Occasional	Very brief	Feb-Nov	>6.0	---	---	>60	---	Moderate	Low	Low.
142 Chaseburg	B	Frequent	Very brief	Nov-Jun	3.0-6.0	Apparent	Nov-Apr	>60	---	High	Moderate	Moderate.
158 Dorchester	B	Rare	---	---	>6.0	---	---	>60	---	High	High	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
162B, 162C, 162C2, 162D, 162D2, 162E2 Downs	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
163B, 163C, 163C2, 163D, 163D2, 163D3, 163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G Fayette	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
171B, 171C2 Bassett	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
177, 177B Saude	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
178 Waukee	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
183C, 183D, 183D2, 183E, 183E2, 183E3, 183F Dubuque	B	None	---	---	>6.0	---	---	20-30	Hard	High	Moderate	Moderate.
196C Volney	B	Frequent	Very brief	Feb-Nov	>6.0	---	---	>60	---	Low	Low	Low.
213B, 214B Rockton	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Low	Low.
215E Goss	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
221B Palms	A/D	None	---	---	+1-1.0	Apparent	Nov-May	>60	---	High	High	Moderate.
225, 226 Lawler	B	None	---	---	2.0-4.0	Apparent	Nov-May	>60	---	High	High	Moderate.
249, 249C Zwingle	D	None	---	---	1.0-2.0	Perched	Nov-Jul	>60	---	Moderate	High	Moderate.
284, 284B Flagler	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
291 Atterberry	B	None	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	High	High	Moderate.
320 Arenzville	B	Frequent	Brief	Nov-Jun	3.0-6.0	Apparent	Nov-Jun	>60	---	High	Moderate	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
323B--------------- Terril	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
391B*:												
Clyde-------------	B/D	None---------	---	---	1.0-2.5	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Floyd-------------	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
408B, 408C--------- Olin	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
444B, 444C, 444D-- Jacwin	B	None---------	---	---	2.0-4.0	Perched	Nov-Jun	36-60	Soft	High-----	High-----	Low.
462B--------------- Downs	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
463B, 463C--------- Fayette	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
471---------------- Oran	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
478G*: Rock outcrop.												
Nordness----------	B	None---------	---	---	>6.0	---	---	8-20	Hard	Low-------	Low-------	Low.
480B, 480C, 480D2, 480E2------------- Orwood	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Moderate.
483C--------------- Frankville	B	None---------	---	---	>6.0	---	---	20-30	Hard	High-----	Moderate	Moderate.
483D2-------------- Frankville	B	None---------	---	---	>6.0	---	---	20-30	Hard	High-----	Moderate	Moderate.
483E2-------------- Frankville	B	None---------	---	---	>6.0	---	---	20-30	Hard	High-----	Moderate	Moderate.
485---------------- Spillville	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Moderate.
487B*:												
Otter-------------	B/D	Frequent----	Brief-----	Apr-Jun	0-2.0	Apparent	Apr-Jun	>60	---	High-----	High-----	Low.
Worthen-----------	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Low-------	Low.
489---------------- Ossian	B/D	Occasional	Very brief	Feb-Nov	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
490---------------- Caneek	B	Frequent----	Very brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
496B*:												
Dorchester	B	Frequent	Very brief to long.	Feb-Nov	>6.0	---	---	>60	---	High	High	Low.
Volney	B	Occasional	Very brief	Feb-Nov	>6.0	---	---	>60	---	Low	Low	Low.
497E*, 497F*:												
Fayette	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
Dubuque	B	None	---	---	>6.0	---	---	20-30	Hard	High	Moderate	Moderate.
499B, 499D, 499F Nordness	B	None	---	---	>6.0	---	---	8-20	Hard	Low	Low	Low.
512B, 512D2 Marlean	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
551 Calamine	D	None	---	---	0-1.0	Perched	Nov-May	30-50	Soft	Moderate	High	Moderate.
589, 589+ Otter	B/D	Frequent	Brief	Apr-Jun	0-2.0	Apparent	Apr-Jun	>60	---	High	High	Low.
612D2, 612E2 Mottland	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
714B, 714C Winneshiek	B	None	---	---	>6.0	---	---	20-30	Hard	Moderate	Moderate	Moderate.
763D2, 763D3, 763E2, 763E3, 763F2, 763F3 Exette	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
776B, 776C Lilah	A	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
777, 777B Wapsie	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
793 Bertrand	B	None	---	---	>6.0	---	---	>60	---	High	Low	Moderate.
826 Rowley	C	Occasional	Brief	Mar-May	1.0-3.0	Apparent	Nov-May	>60	---	High	High	Moderate.
863B, 863D Fayette	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
902C, 902D2 Luana	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
926 Canoe	B	Rare	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High	High	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
930, 930B---------- Orion	C	Frequent----	Brief-----	Mar-Nov	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
951F--------------- Medary Variant	D	None---------	---	---	3.0-6.0	Perched	Nov-Jul	>60	---	Moderate	High-----	Moderate.
977---------------- Richwood	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
978---------------- Festina	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
981B--------------- Worthen	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
1158--------------- Dorchester	B	Frequent----	Very brief to long.	Feb-Nov	>6.0	---	---	>60	---	High-----	High-----	Low.
1212--------------- Kennebec	B	Occasional	Brief-----	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	High-----	Moderate	Low.
1219--------------- Canoe Variant	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Moderate.
1490--------------- Caneek	B	Frequent----	Very brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
5010*, 5030*. Pits												
5040*. Orthents												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Ankeny	Coarse-loamy, mixed, mesic Cumulic Hapludolls
Arenzville	Coarse-silty, mixed, nonacid, mesic Typic Udifluvents
Atterberry	Fine-silty, mixed, mesic Udollic Ochraqualfs
Backbone	Coarse-loamy, mixed, mesic Mollic Hapludalfs
Bassett	Fine-loamy, mixed, mesic Mollic Hapludalfs
*Bertrand	Fine-silty, mixed, mesic Typic Hapludalfs
*Calamine	Fine, mixed, mesic Typic Argiaquolls
Caneek	Fine-silty, mixed (calcareous), mesic Typic Fluvaquents
*Canoe	Fine-silty, mixed, mesic Udollic Ochraqualfs
Canoe Variant	Fine-silty, mixed, mesic Typic Ochraqualfs
Chaseburg	Coarse-silty, mixed, nonacid, mesic Typic Udifluvents
Chelsea	Mixed, mesic Alfic Udipsamments
Clyde	Fine-loamy, mixed, mesic Typic Haplaquolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Dorchester	Fine-silty, mixed (calcareous), mesic Typic Udifluvents
Downs	Fine-silty, mixed, mesic Mollic Hapludalfs
Dubuque	Fine-silty, mixed, mesic Typic Hapludalfs
Exette	Fine-silty, mixed, mesic Dystric Eutrochrepts
Fayette	Fine-silty, mixed, mesic Typic Hapludalfs
Festina	Fine-silty, mixed, mesic Mollic Hapludalfs
Flagler	Coarse-loamy, mixed, mesic Typic Hapludolls
Floyd	Fine-loamy, mixed, mesic Aquic Hapludolls
Frankville	Fine-silty, mixed, mesic Mollic Hapludalfs
Goss	Clayey-skeletal, mixed, mesic Typic Paleudalfs
Huntsville	Fine-silty, mixed, mesic Cumulic Hapludolls
Jacwin	Fine-loamy over clayey, mixed, mesic Aquic Hapludolls
*Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
Kenyon	Fine-loamy, mixed, mesic Typic Hapludolls
Lamont	Coarse-loamy, mixed, mesic Typic Hapludalfs
Lawler	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
*Lilah	Sandy, mixed, mesic Psammentic Hapludalfs
Lindley	Fine-loamy, mixed, mesic Typic Hapludalfs
Luana	Fine-silty, mixed, mesic Mollic Hapludalfs
Marlean	Loamy-skeletal, mixed, mesic Typic Hapludolls
Medary Variant	Clayey over loamy, mixed, mesic Typic Hapludalfs
Mottland	Coarse-loamy, carbonatic, mesic Entic Hapludolls
Nordness	Loamy, mixed, mesic Lithic Hapludalfs
Olin	Coarse-loamy, mixed, mesic Typic Hapludolls
Oran	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Orion	Coarse-silty, mixed, nonacid, mesic Aquic Udifluvents
Orthents	Loamy, mixed, mesic Typic Udorthents
Orwood	Fine-loamy, mixed, mesic Mollic Hapludalfs
Ossian	Fine-silty, mixed, mesic Typic Haplaquolls
Otter	Fine-silty, mixed, mesic Cumulic Haplaquolls
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
*Richwood	Fine-silty, mixed, mesic Typic Argiudolls
Rockton	Fine-loamy, mixed, mesic Typic Argiudolls
*Rowley	Fine-silty, mixed, mesic Aquic Argiudolls
Saude	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Sparta	Sandy, mixed, mesic Entic Hapludolls
Spillville	Fine-loamy, mixed, mesic Cumulic Hapludolls
Tama	Fine-silty, mixed, mesic Typic Argiudolls
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Volney	Loamy-skeletal, mixed, mesic Cumulic Hapludolls
Wapsie	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Hapludalfs
Waukee	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Winneshiek	Fine-loamy, mixed, mesic Mollic Hapludalfs
Worthen	Fine-silty, mixed, mesic Cumulic Hapludolls
Zwingle	Fine, montmorillonitic, mesic Typic Albaqualfs

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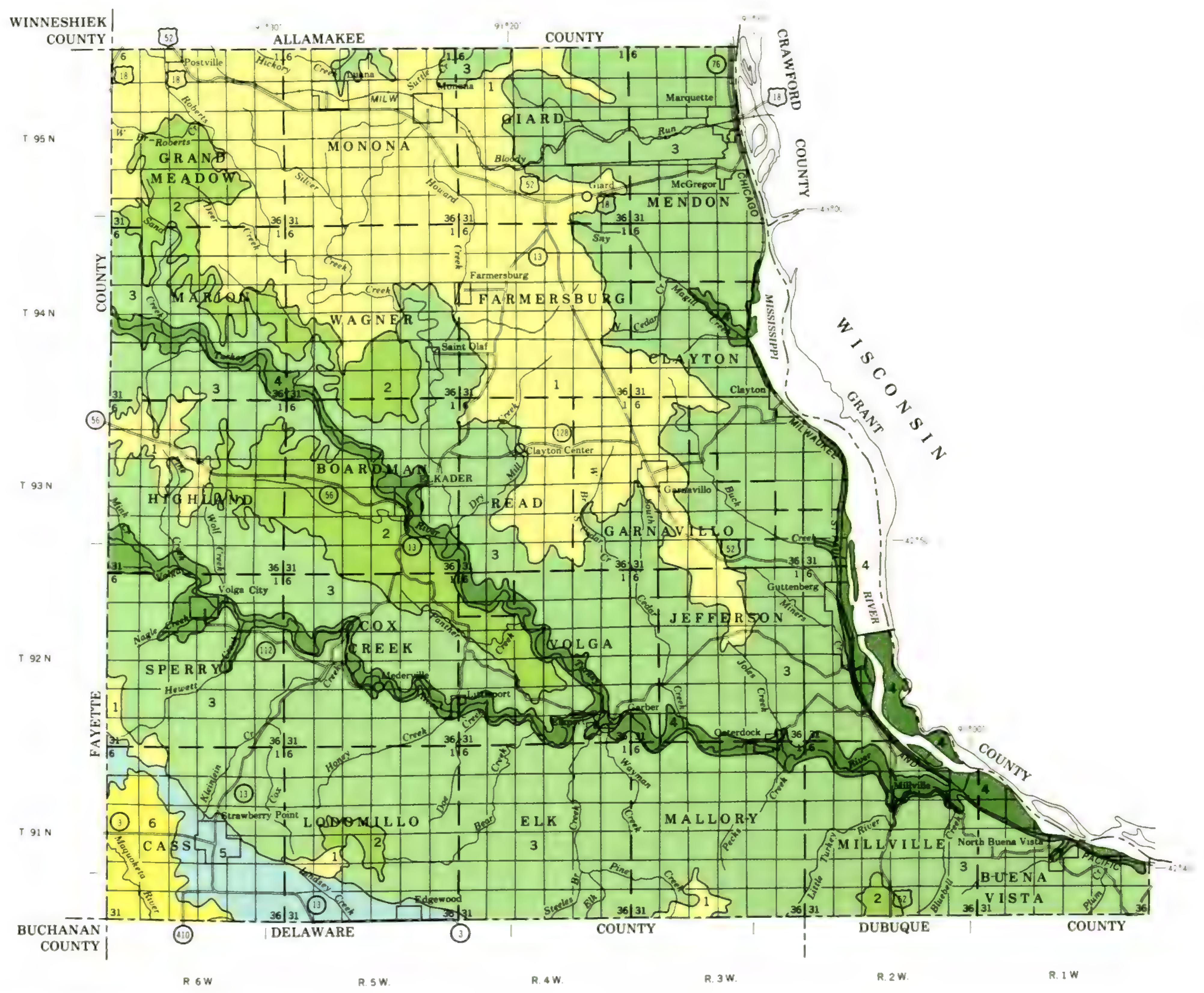
NRCS Accessibility Statement

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
IOWA AGRICULTURE AND HOME ECONOMICS EXPERIMENT STATION
COOPERATIVE EXTENSION SERVICE, IOWA STATE UNIVERSITY
DEPARTMENT OF SOIL CONSERVATION, STATE OF IOWA

GENERAL SOIL MAP

CLAYTON COUNTY, IOWA

Scale 1: 253,440



SOIL LEGEND

1	Downs-Fayette association: Gently sloping to moderately steep, well drained soils formed in loess on uplands
2	Fayette-Exette-Lindley association: Strongly sloping to very steep, well drained and moderately well drained soils formed in loess and glacial till on uplands
3	Fayette-Nordness-Rock outcrop association: Rock outcrop and moderately sloping to very steep, well drained soils formed in loess or in loamy surficial sediments and the underlying residuum of limestone; on uplands
4	Dorchester-Bertrand-Wapsie association: Nearly level to gently sloping, moderately well drained and well drained soils formed in silty, loamy, and sandy alluvial sediments on bottom land and stream benches
5	Kenyon-Clyde-Floyd association: Nearly level to gently sloping, moderately well drained to poorly drained soils formed in loamy surficial sediments and the underlying glacial till on uplands
6	Bassett-Backbone-Winneshiek association: Gently sloping to strongly sloping, moderately well drained to somewhat excessively drained soils formed in loamy surficial sediments, glacial till, and residuum of limestone on uplands

Compiled 1981

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

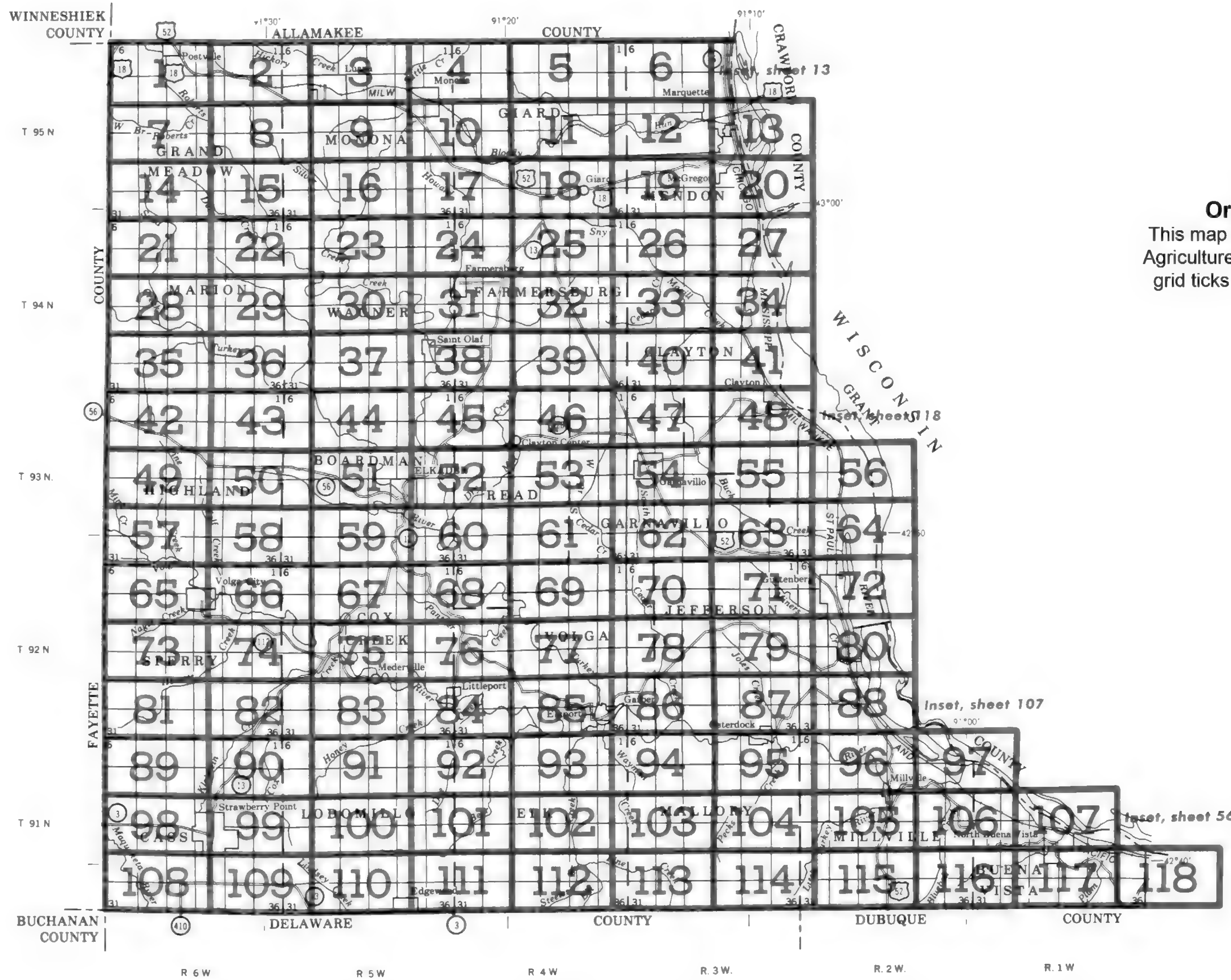
INDEX TO MAP SHEETS
CLAYTON COUNTY, IOWA

Scale 1: 253,440

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

Original text from each individual map sheet read:
This map is compiled on 1972 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate — 79
- Federal — 410
- State — 52
- County, farm or ranch — 378

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water; w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 133; 162C2

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) — S

MISCELLANEOUS

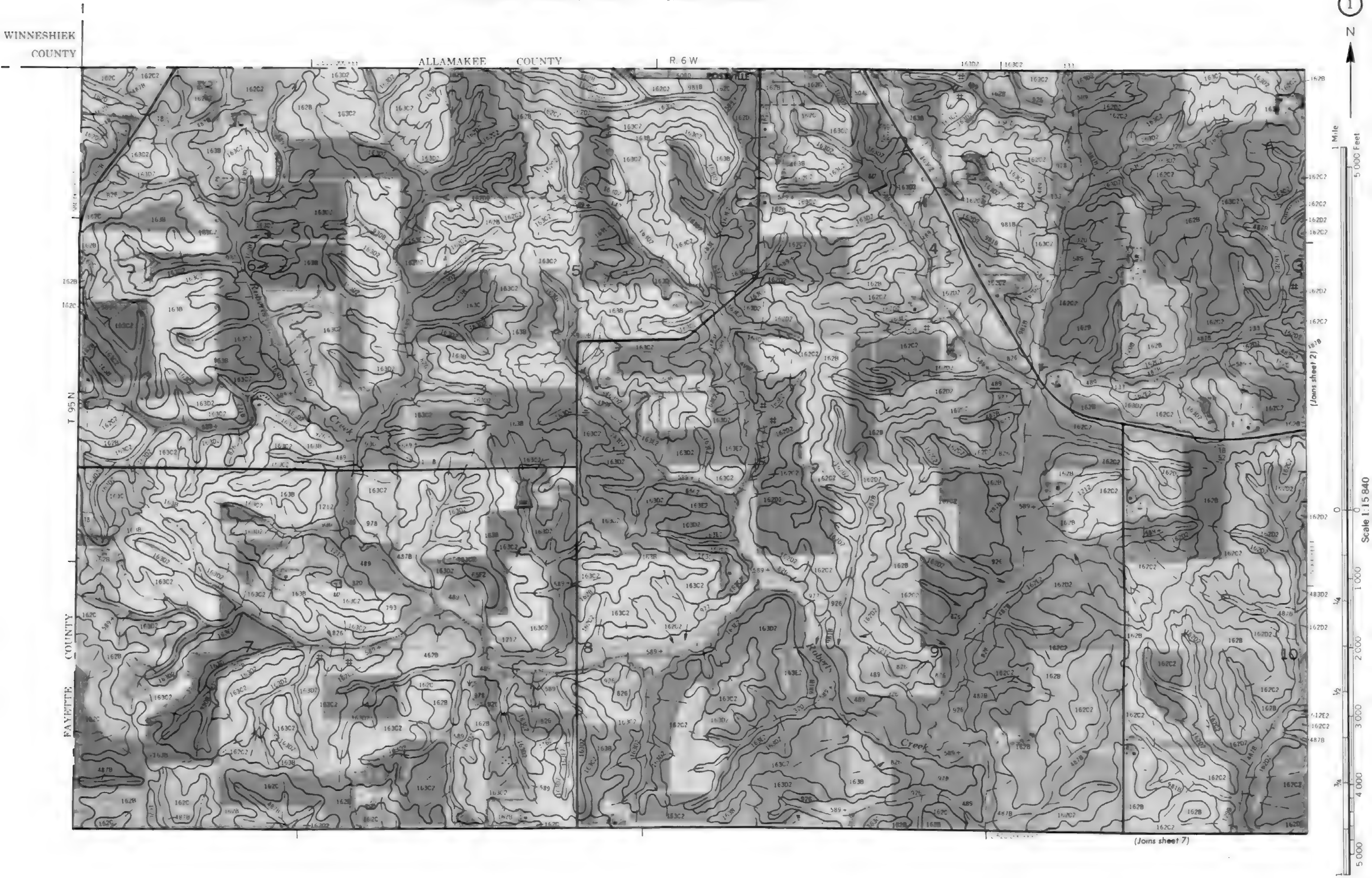
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Sinkhole not crossable with farm machinery
- Muck or peaty muck spot
- Limestone at a depth of 20 to 40 inches
- Shale within a depth of 40 inches
- Cherty spot
- Glacial till spot
- Sewage lagoon — S.L

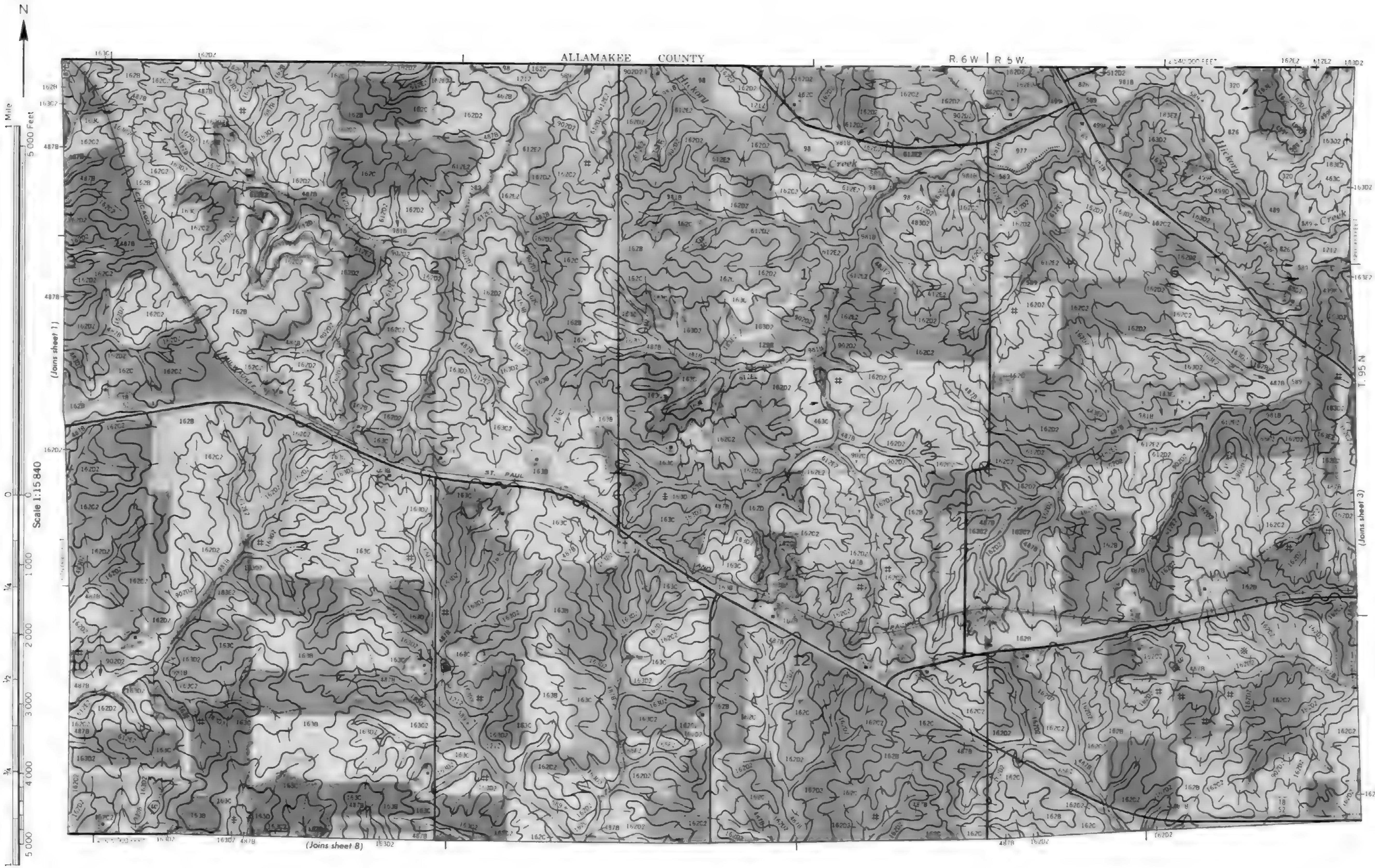
SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and letters. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is moderately eroded and 3 that it is severely eroded.

SYMBOL	NAME
40	Fayette silt loam karst 9 to 25 percent slopes
41B	Sparta loamy fine sand 2 to 5 percent slopes
41C	Sparta loamy fine sand 5 to 12 percent slopes
63B	Chelsea loamy fine sand 2 to 5 percent slopes
63C	Chelsea loamy fine sand 5 to 14 percent slopes
63E	Chelsea loamy fine sand 14 to 25 percent slopes
65D2	Lindley loam 9 to 14 percent slopes moderately eroded
65F2	Lindley loam 14 to 25 percent slopes moderately eroded
65F3	Lindley loam 14 to 25 percent slopes severely eroded
83B	Kenyon loam 2 to 5 percent slopes
84	Clyde clay loam 1 to 3 percent slopes
98	Huntsville silt loam 0 to 2 percent slopes
109B	Backbone fine sandy loam 2 to 5 percent slopes
109C	Backbone fine sandy loam 5 to 9 percent slopes
109D	Backbone fine sandy loam 9 to 14 percent slopes
110	Lamont fine sandy loam 0 to 2 percent slopes
110B	Lamont fine sandy loam 2 to 5 percent slopes
110C	Lamont fine sandy loam 5 to 9 percent slopes
120B	Tama silt loam 2 to 5 percent slopes
120C	Tama silt loam 5 to 9 percent slopes
129B	Arenzville-Chaseburg silt loams 1 to 5 percent slopes
133	Colo silty clay loam 0 to 2 percent slopes
136	Ankeny fine sandy loam 0 to 2 percent slopes
142	Chaseburg silt loam 0 to 2 percent slopes
158	Dorchester silt loam 0 to 2 percent slopes
162B	Downs silt loam 2 to 5 percent slopes
162C	Downs silt loam 5 to 9 percent slopes
162C2	Downs silt loam 5 to 9 percent slopes moderately eroded
162D	Downs silt loam 9 to 14 percent slopes
162D2	Downs silt loam 9 to 14 percent slopes moderately eroded
162E2	Downs silt loam 14 to 18 percent slopes moderately eroded
163B	Fayette silt loam 2 to 5 percent slopes
163C	Fayette silt loam 5 to 9 percent slopes
163C2	Fayette silt loam 5 to 9 percent slopes moderately eroded
163D	Fayette silt loam 9 to 14 percent slopes
163D2	Fayette silt loam 9 to 14 percent slopes moderately eroded
163D3	Fayette silty clay loam 9 to 14 percent slopes severely eroded
163E	Fayette silt loam 14 to 18 percent slopes
163E2	Fayette silt loam 14 to 18 percent slopes moderately eroded
163E3	Fayette silty clay loam 14 ro 18 percent slopes severely eroded
163F	Fayette silt loam 18 to 25 percent slopes
163F2	Fayette silt loam 18 to 25 percent slopes moderately eroded
163F3	Fayette silty clay loam 18 to 25 percent slopes severely eroded
163G	Fayette silt loam 25 to 40 percent slopes
171B	Bassett loam 2 to 5 percent slopes
171C2	Bassett loam 5 to 9 percent slopes moderately eroded
177	Saude loam 0 to 2 percent slopes
177B	Saude loam 2 to 5 percent slopes
178	Waukee loam 0 to 2 percent slopes
183C	Dubuque silt loam 20 to 30 inches to limestone 5 to 9 percent slopes
183D	Dubuque silt loam 20 to 30 inches to limestone 9 to 14 percent slopes
183D2	Dubuque silt loam 20 to 30 inches to limestone 9 to 14 percent slopes moderately eroded
183E	Dubuque silt loam 20 to 30 inches to limestone 14 to 18 percent slopes
183E2	Dubuque silt loam 20 to 30 inches to limestone 14 to 18 percent slopes moderately eroded
183E3	Dubuque silty clay loam 20 to 30 inches to limestone 14 to 18 percent slopes severely eroded
183F	Dubuque silt loam 20 to 30 inches to limestone 18 to 25 percent slopes
196C	Volney channery silt loam 5 to 12 percent slopes
213B	Rockton loam 30 to 40 inches to limestone 2 to 5 percent slopes
214B	Rockton loam 20 to 30 inches to limestone 2 to 5 percent slopes
215E	Goss loam 9 to 18 percent slopes
221B	Palms muck 1 to 4 percent slopes
225	Lawler loam 24 to 32 inches to sand and gravel 0 to 2 percent slopes
226	Lawler loam 32 to 40 inches to sand and gravel 0 to 2 percent slopes
249	Zwingle silt loam 0 to 2 percent slopes
249C	Zwingle silt loam 2 to 9 percent slopes
284	Flagler sandy loam 0 to 2 percent slopes
284B	Flagler sandy loam 2 to 5 percent slopes
291	Atterberry silt loam 1 to 3 percent slopes
320	Arenzville silt loam 0 to 2 percent slopes
323B	Terril loam sandy substratum 2 to 5 percent slopes
391B	Clyde-Floyd complex 1 to 4 percent slopes
408B	Olin fine sandy loam 2 to 5 percent slopes
408C	Olin fine sandy loam 5 to 9 percent slopes
444B	Jacwin loam 2 to 5 percent slopes
444C	Jacwin loam 5 to 9 percent slopes
444D	Jacwin loam 9 to 14 percent slopes
462B	Downs silt loam benches 2 to 5 percent slopes
463B	Fayette silt loam benches 2 to 5 percent slopes
463C	Fayette silt loam benches 5 to 9 percent slopes
471	Oran loam 0 to 2 percent slopes
478G	Rock outcrop-Nordness complex 25 to 60 percent slopes
480B	Orwood silt loam 2 to 5 percent slopes
480C	Orwood silt loam 5 to 9 percent slopes
480D2	Orwood silt loam 9 to 14 percent slopes moderately eroded
480E2	Orwood silt loam 14 to 18 percent slopes moderately eroded
483C	Frankville silt loam 20 to 30 inches to limestone 5 to 9 percent slopes
483D2	Frankville silt loam 20 to 30 inches to limestone 9 to 14 percent slopes moderately eroded
483E2	Frankville silt loam 20 to 30 inches to limestone 14 to 18 percent slopes moderately eroded
485	Spillville loam 0 to 2 percent slopes
487B	Otter-Worthen silt loams 1 to 4 percent slopes
489	Ossian silt loam 0 to 2 percent slopes
490	Caneek silt loam 0 to 2 percent slopes
496B	Dorchester Volney complex 1 to 5 percent slopes
497E	Fayette Dubuque silt loams 14 to 18 percent slopes
497F	Fayette Dubuque silt loams 18 to 30 percent slopes
499B	Nordness silt loam 2 to 5 percent slopes
499D	Nordness silt loam 5 to 14 percent slopes
499F	Nordness silt loam 14 to 25 percent slopes
512B	Marlean loam 2 to 5 percent slopes
512D2	Marlean loam 5 to 14 percent slopes moderately eroded
551	Calamine loam 1 to 3 percent slopes
589	Otter silt loam 0 to 2 percent slopes
589 +	Otter silt loam overwash 0 to 2 percent slopes
612D2	Mottland silt loam 5 to 14 percent slopes moderately eroded
612E2	Mottland silt loam 14 to 18 percent slopes moderately eroded
714B	Winneshiek loam 20 to 30 inches to limestone 2 to 5 percent slopes
714C	Winneshiek loam 20 to 30 inches to limestone 5 to 9 percent slopes
763D2	Exette silt loam 9 to 14 percent slopes moderately eroded
763D3	Exette silt loam 9 to 14 percent slopes severely eroded
763E2	Exette silt loam 14 to 18 percent slopes moderately eroded
763E3	Exette silt loam 14 to 18 percent slopes severely eroded
763F2	Exette silt loam 18 to 25 percent slopes moderately eroded
763F3	Exette silt loam 18 to 25 percent slopes severely eroded
776B	Lilah sandy loam 2 to 5 percent slopes
776C	Lilah sandy loam 5 to 9 percent slopes
777	Wapsie loam 0 to 2 percent slopes
777B	Wapsie loam 2 to 5 percent slopes
793	Bertrand silt loam 0 to 2 percent slopes
826	Rowley silt loam 0 to 2 percent slopes
863B	Fayette silt loam karst 2 to 5 percent slopes
863D	Fayette silt loam karst 5 to 14 percent slopes
902C	Luana silt loam 5 to 9 percent slopes
902D2	Luana silt loam 9 to 14 percent slopes moderately eroded
926	Canoe silt loam 0 to 2 percent slopes
930	Orion silt loam 0 to 2 percent slopes
930B	Orion silt loam 2 to 5 percent slopes
951F	Medary Variant silt loam 18 to 30 percent slopes
977	Richwood silt loam 0 to 2 percent slopes
978	Festina silt loam 0 to 2 percent slopes
981B	Worthen silt loam 2 to 5 percent slopes
1158	Dorchester silt loam channeled 0 to 2 percent slopes
1212	Kennebec silt loam 0 to 2 percent slopes
1219	Canoe Variant silt loam 0 to 2 percent slopes
1490	Caneek silt loam channeled 0 to 2 percent slopes
5010	Pits sand and gravel
5030	Pits limestone quarries
5040	Orthents loamy

CLAYTON COUNTY, IOWA — SHEET NUMBER 1




N
ALLAMAKEE COUNTY
R. 6 W.
R. 5 W.
T. 95 N.
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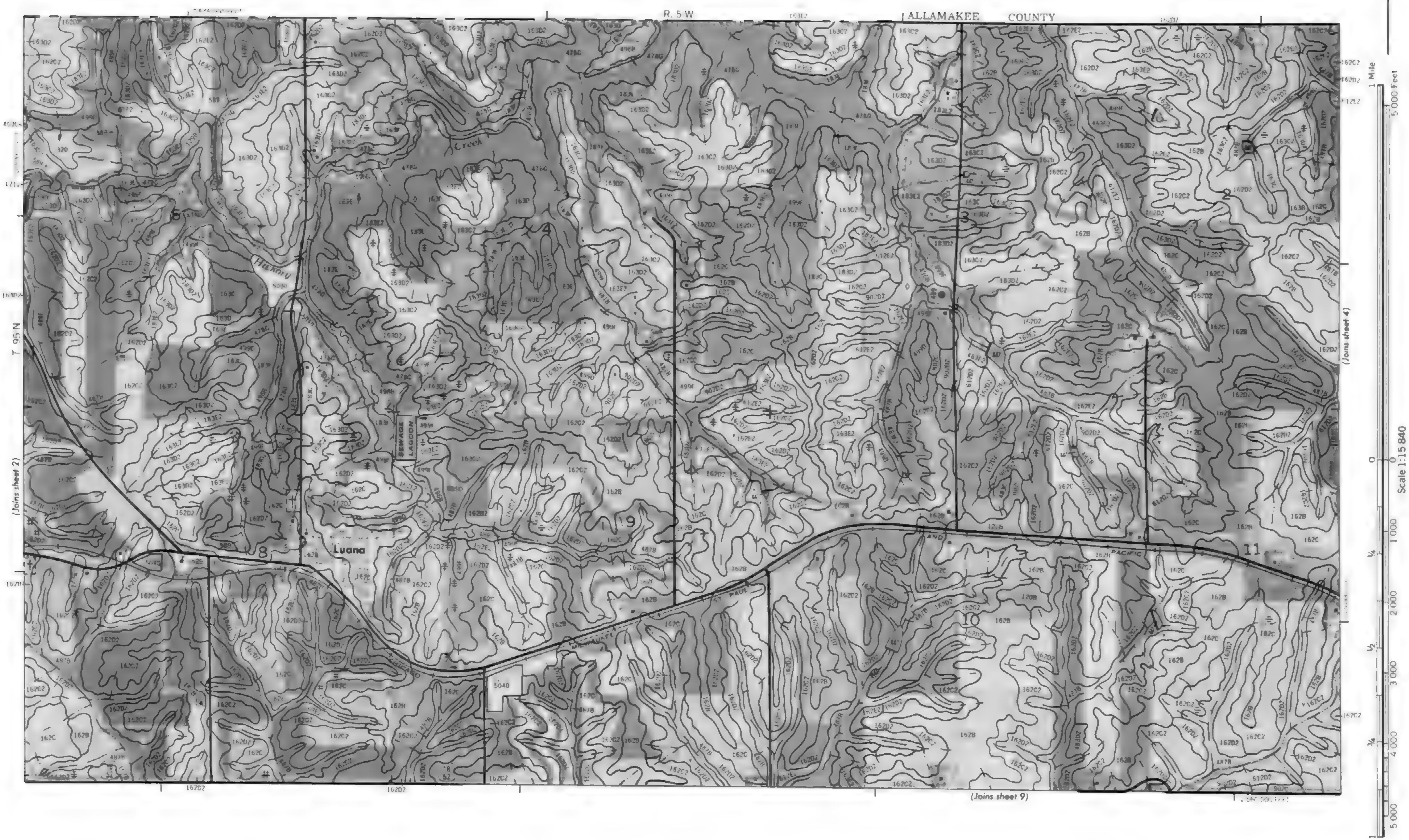
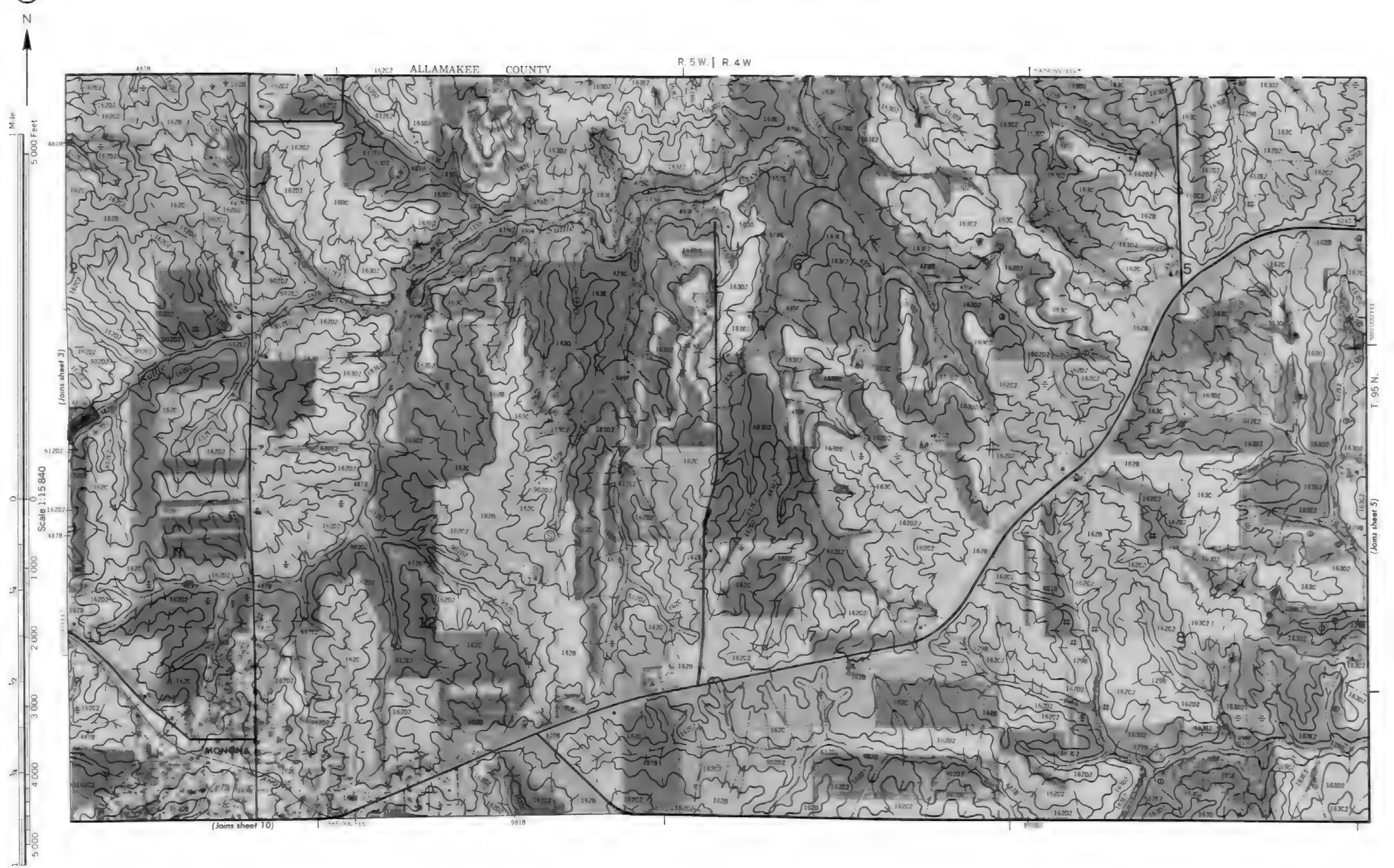
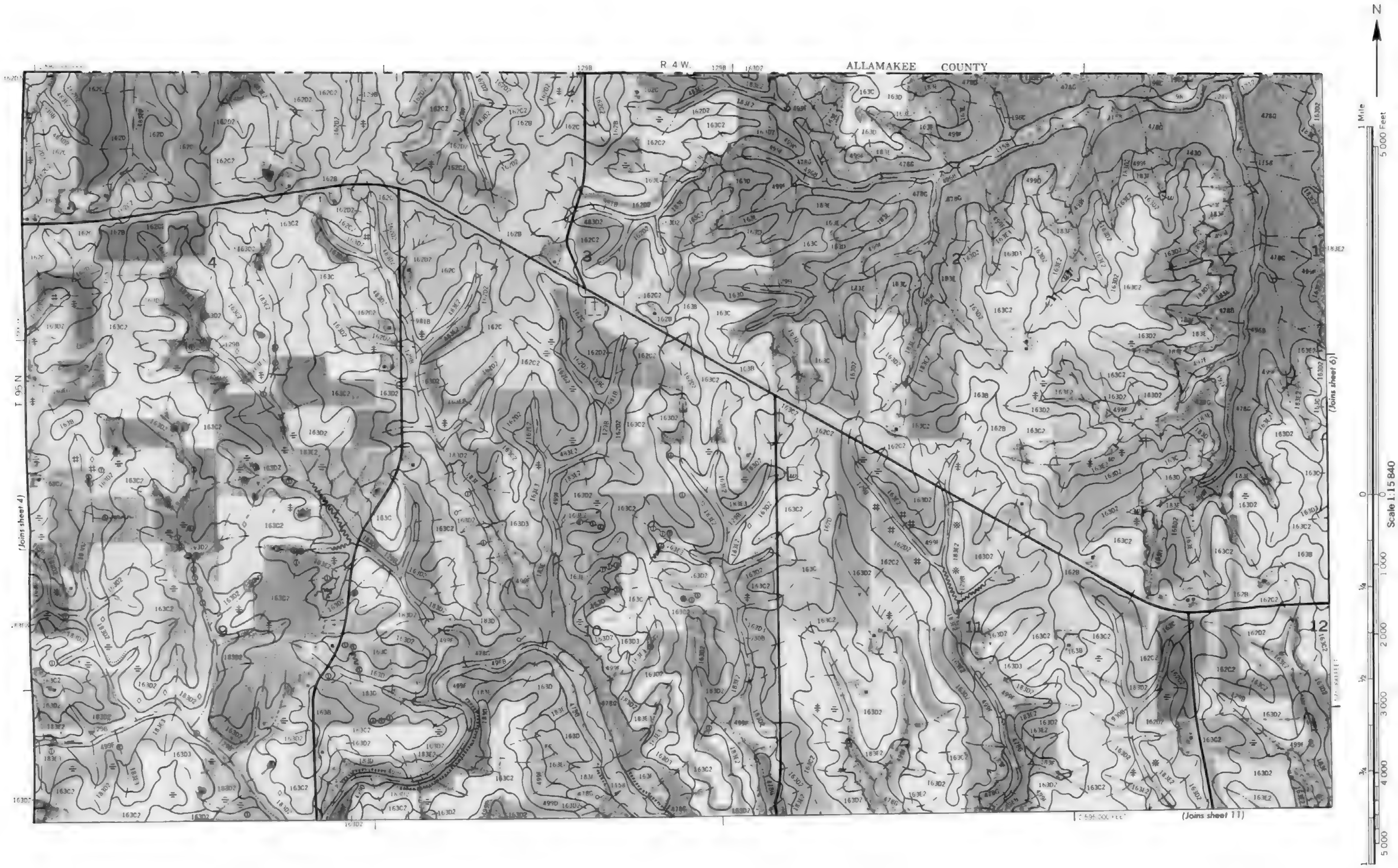
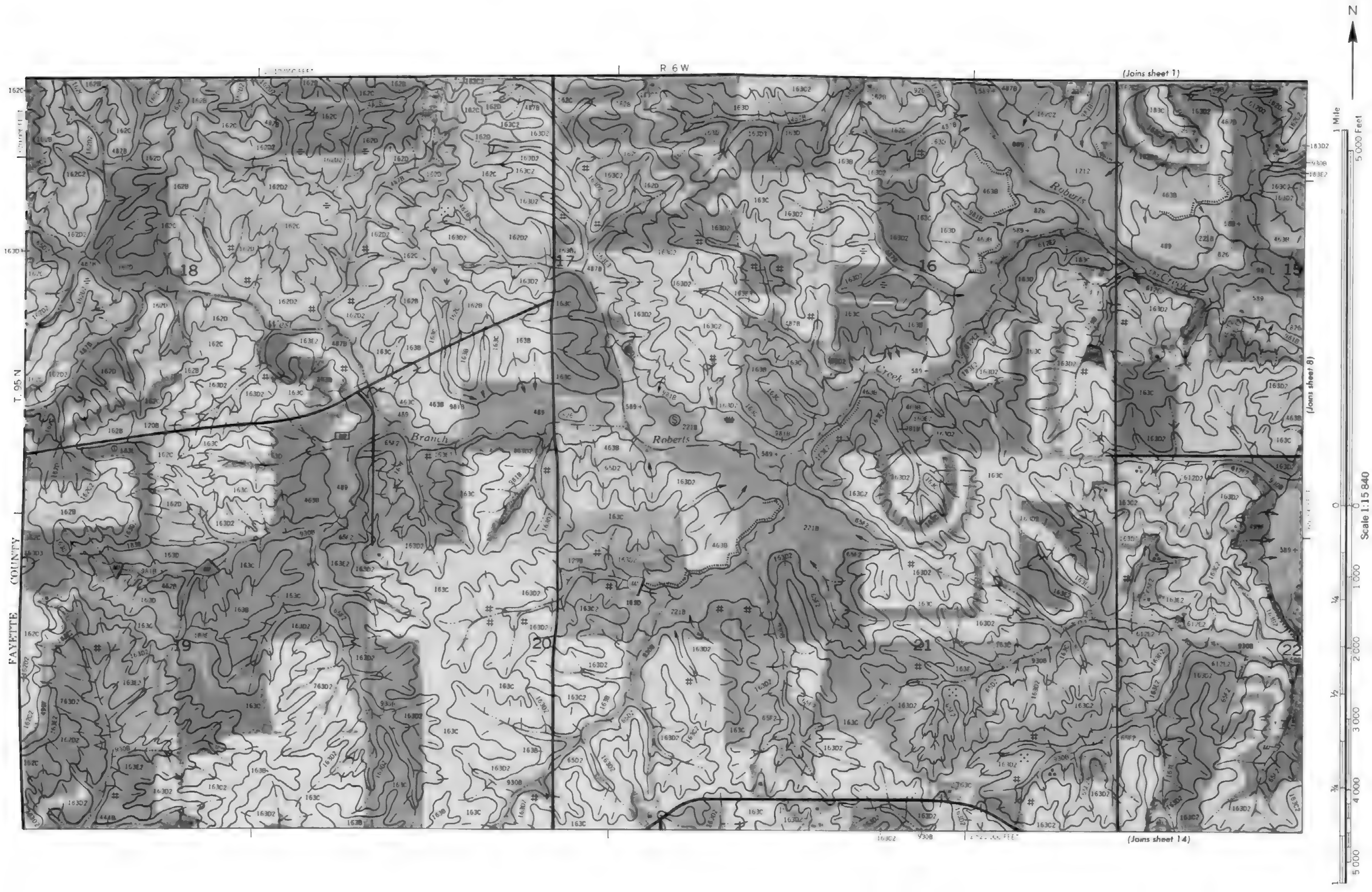
(Joins sheet 3)
(Joins sheet 8)
Scale 1:15 840
1 Mile
5 000 Feet
Hickory
Creek
ST. PAUL

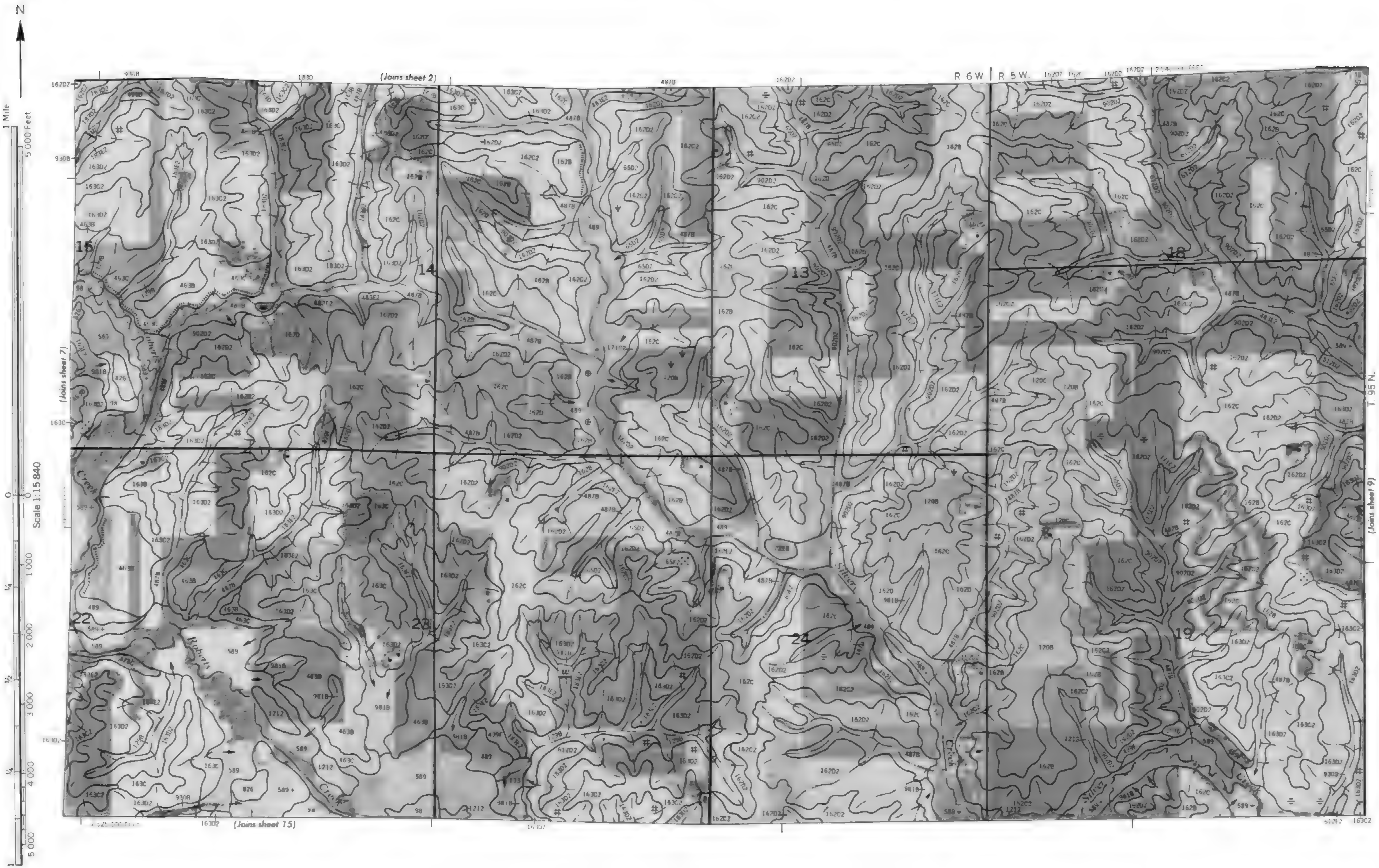

R. 5 W.
ALLAMAKEE COUNTY
T. 95 N.
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 9)
Hickory
Creek
SEWAGE LAGOON
Luana
CHICAGO MILWAUKEE ST PAUL AND PACIFIC
N
1 Mile
5 000 Feet
Scale 1:15 840

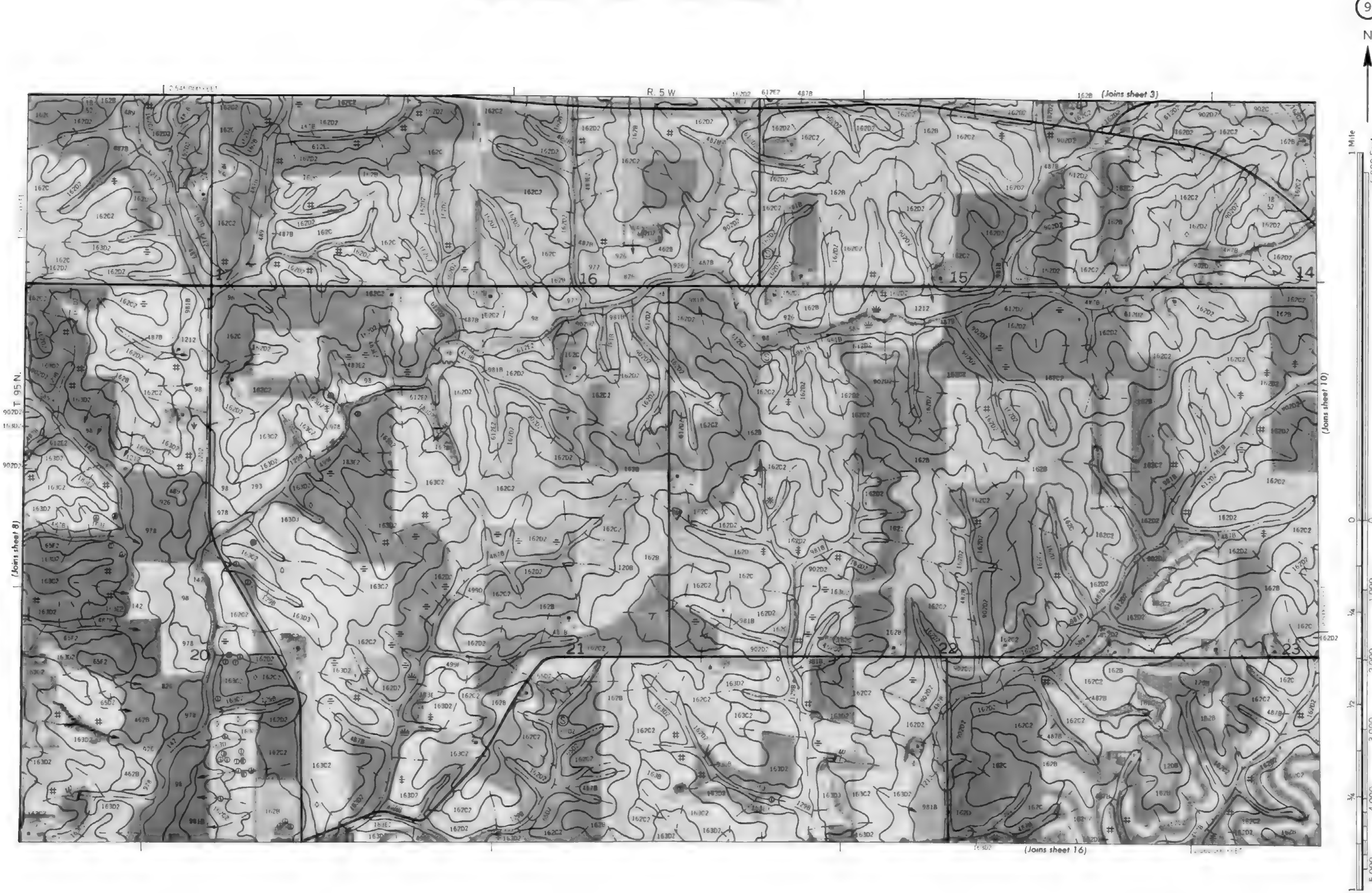

4
N
ALLAMAKEE COUNTY
R. 5 W. | R. 4 W.
T. 95 N.
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 10)
MONONA
Scale 1:15 840
1 Mile
5 000 Feet


R 4 W.
ALLAMAKEE COUNTY
T 95 N
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 11)
N
1 Mile
5 000 Feet
Scale 1:15 840
1
2
3
4
10
11
12

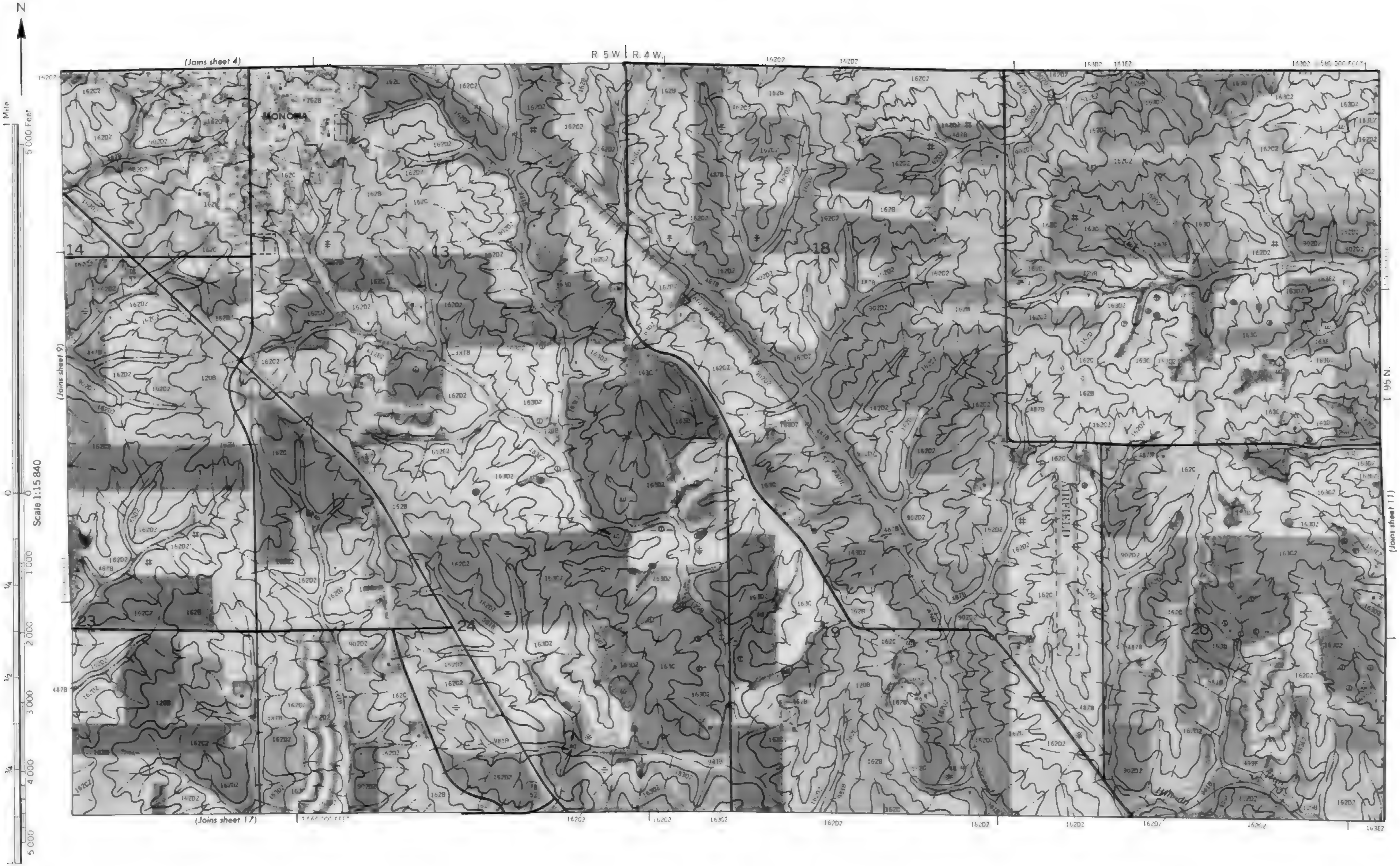

6
N
R. 4 W. | R. 3 W.
ALLAMAKEE COUNTY
(Joins sheet 5)
(Joins sheet 12)
(Joins inset, sheet 13)
T. 95 N.
Scale 1:15 840
1 Mile
5 000 Feet

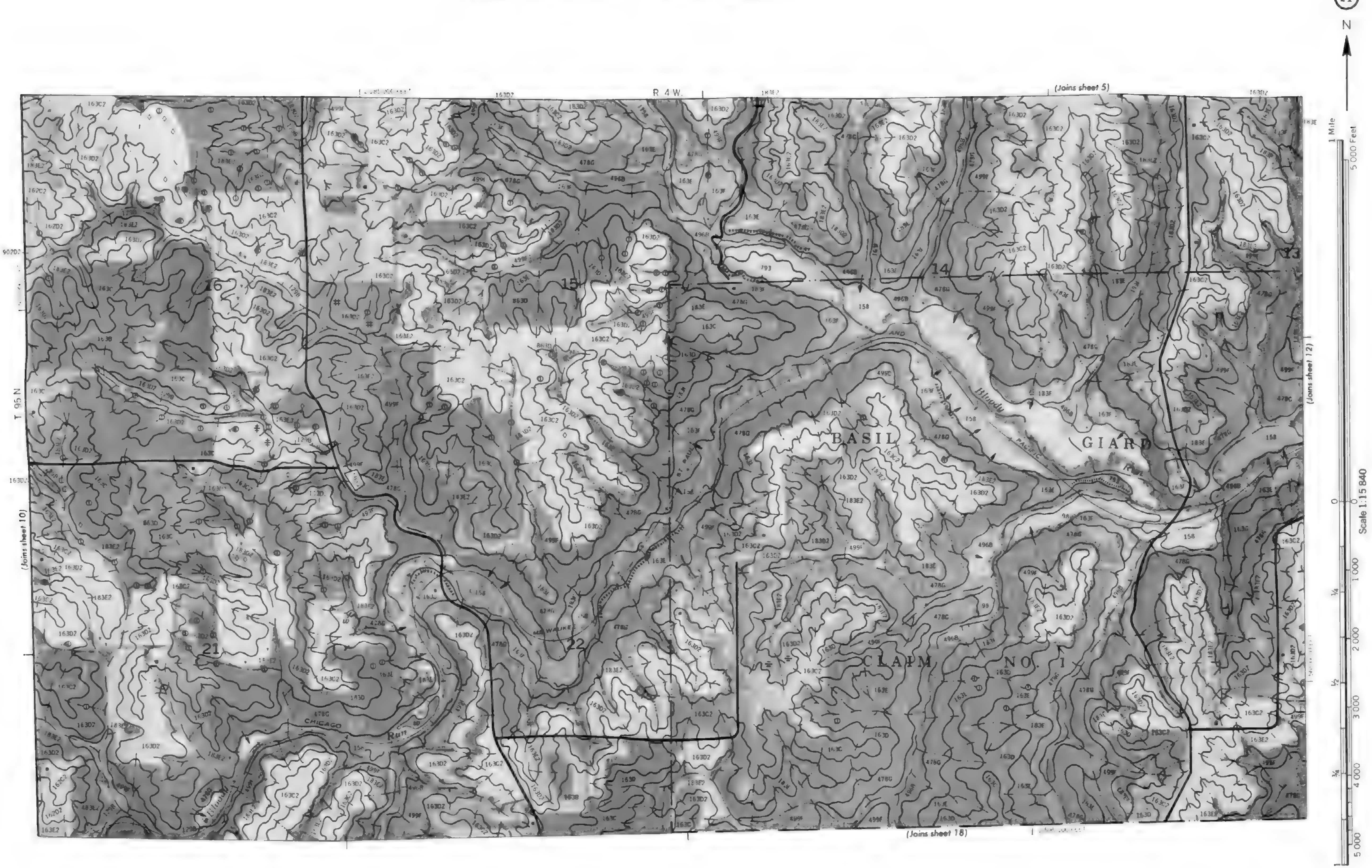

N
R 6 W
(Joins sheet 1)
(Joins sheet 8)
(Joins sheet 14)
T. 95 N.
FAYETTE COUNTY
Roberts
Creek
Branch
West
16
17
18
19
20
21
22
15
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 2)
R 6 W.
R 5 W.
(Joins sheet 7)
(Joins sheet 9)
(Joins sheet 15)
T. 95 N.
15
14
13
18
22
23
24
19
Roberts
Creek

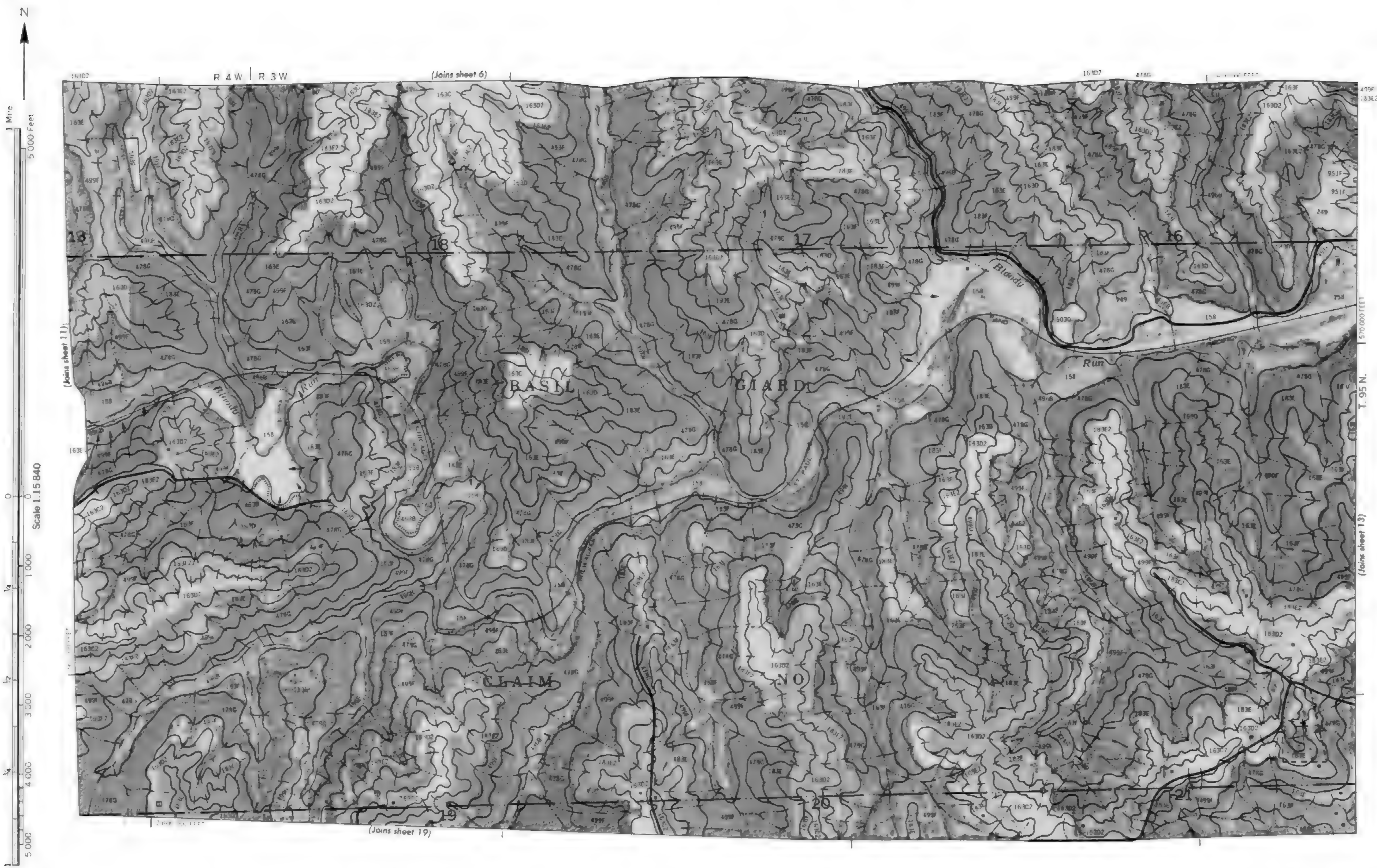

9
N
R. 5 W
(Joins sheet 3)
(Joins sheet 10)
(Joins sheet 16)
(Joins sheet 8)
T. 95 N.
17
16
15
14
20
21
22
23
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000

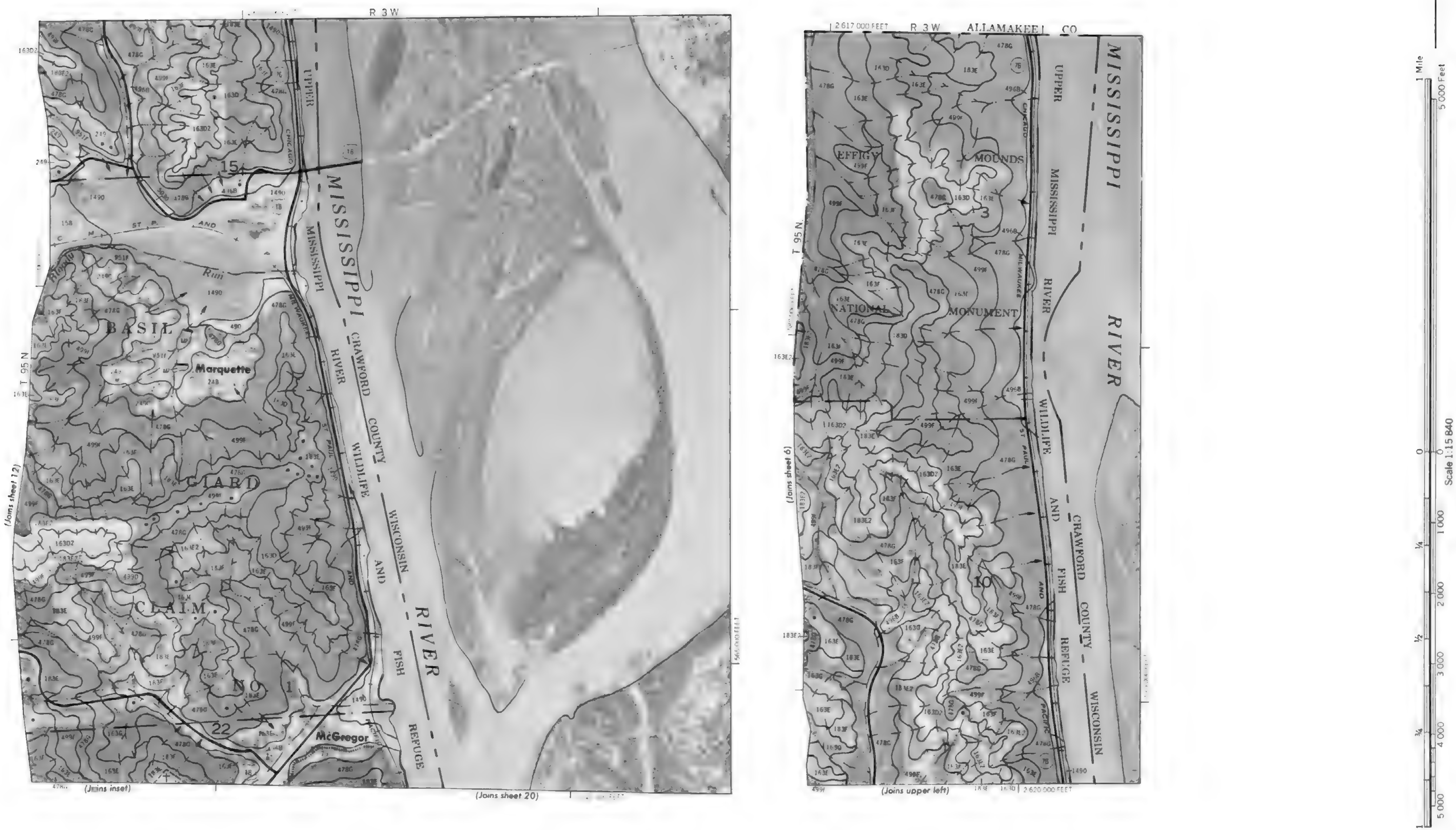
CLAYTON COUNTY, IOWA — SHEET NUMBER 10



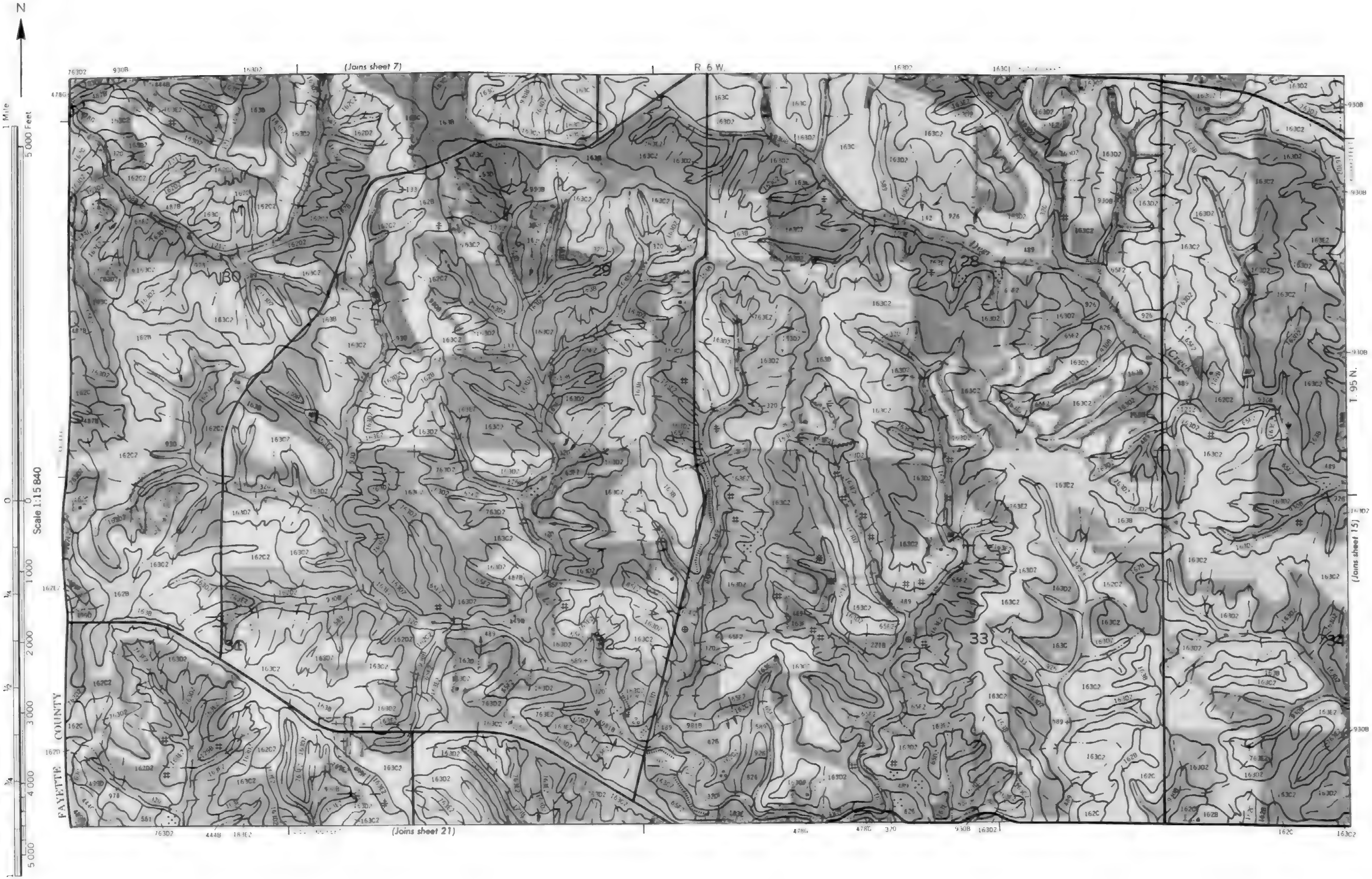

11
N
(Joins sheet 5)
R. 4 W.
T 95 N
(Joins sheet 10)
(Joins sheet 12)
(Joins sheet 18)
BASIL
GIARD
CLAIM NO. 1
Bloody Run
Chicago
Milwaukee
St. Paul
Pacific
16
15
14
13
21
22
1 Mile
5 000 Feet
Scale 1:15 840

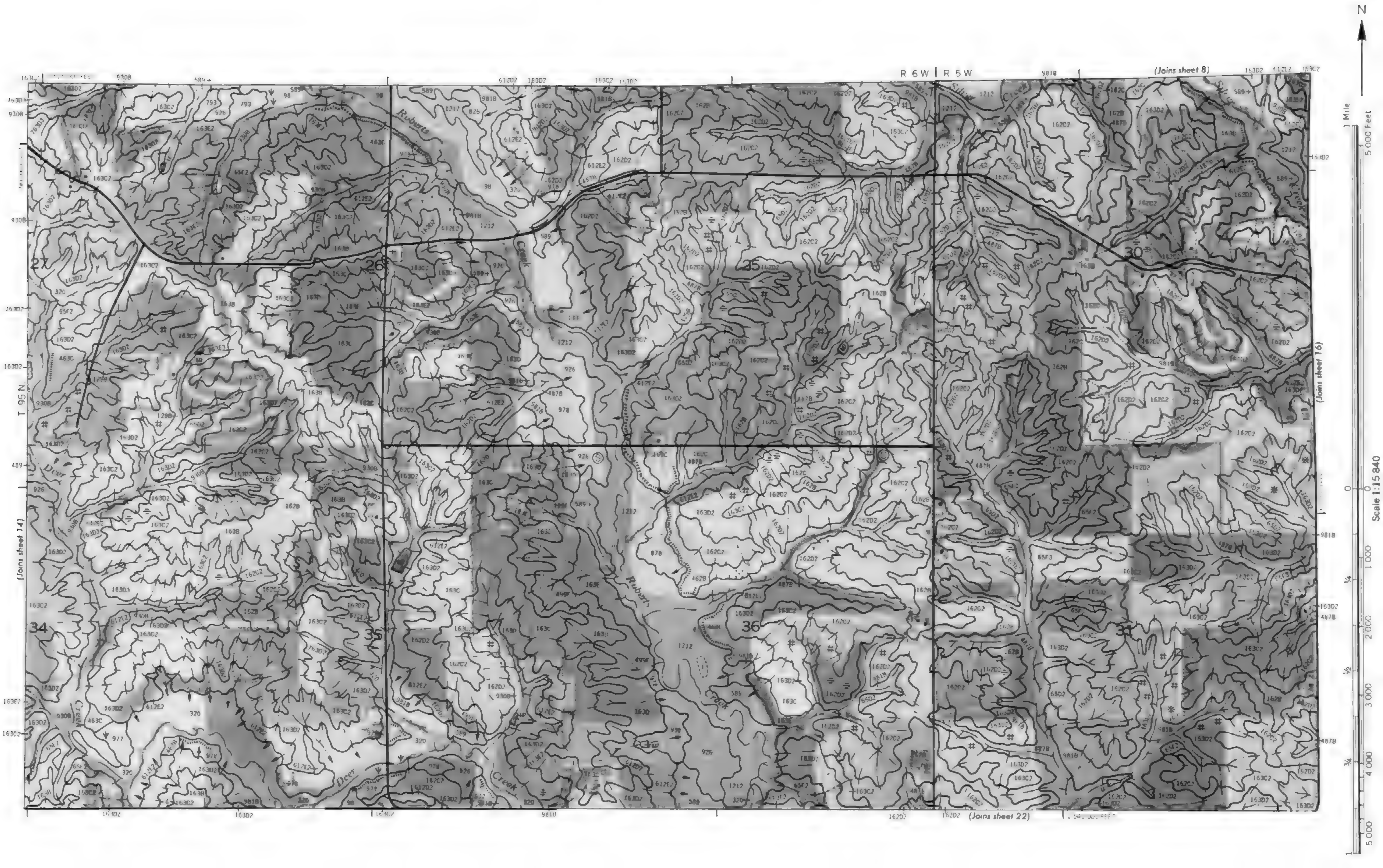
CLAYTON COUNTY, IOWA — SHEET NUMBER 12



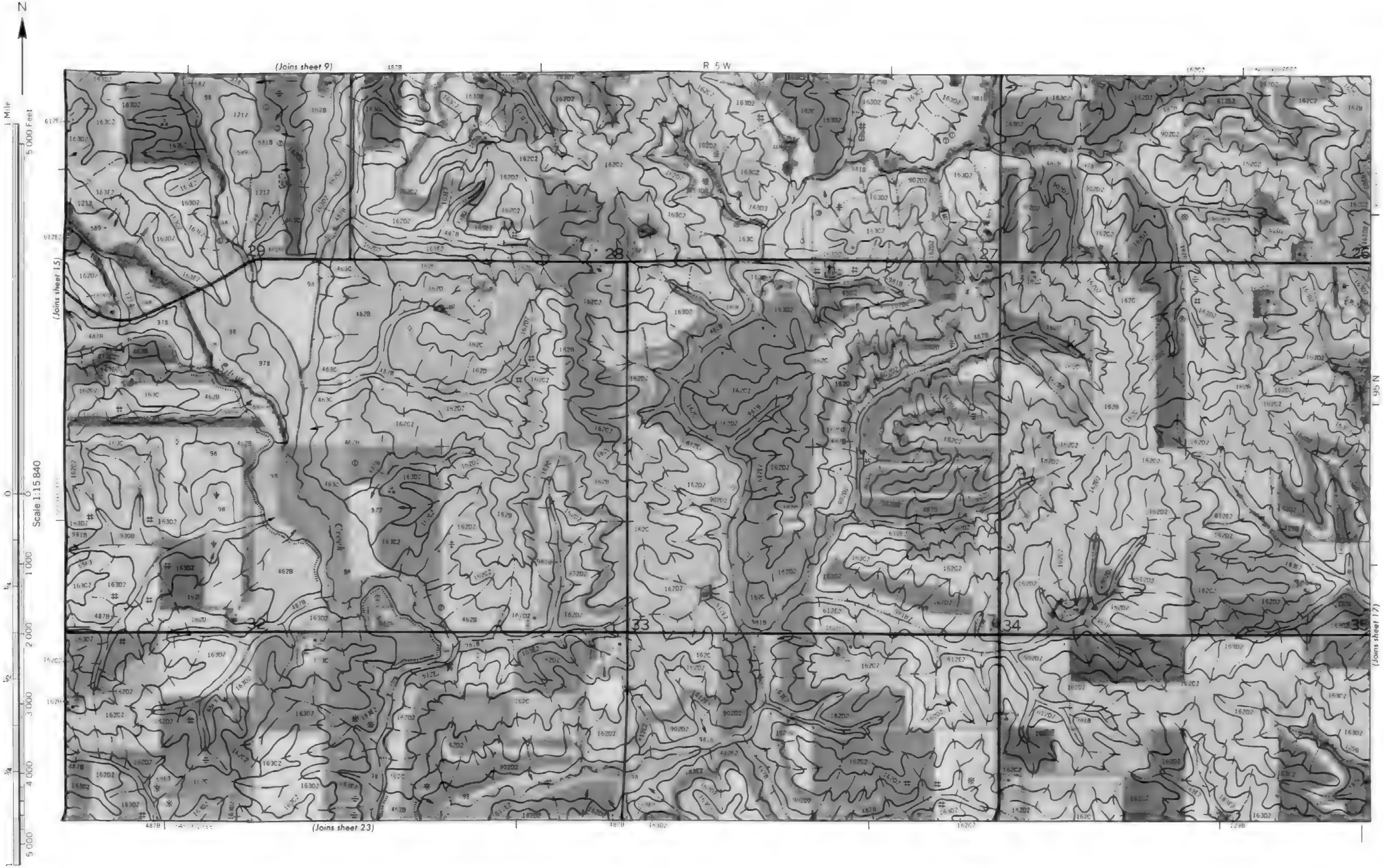

R 3 W
T 95 N.
UPPER MISSISSIPPI RIVER CRAWFORD COUNTY WILDLIFE AND FISH REFUGE
MISSISSIPPI RIVER
BASIL GIARD CLAIM NO 1
Marquette
McGregor
15
22
(Joins sheet 12)
(Joins inset)
(Joins sheet 20)
2 617 000 FEET
R 3 W
ALLAMAKEE CO
EFFIGY MOUNDS NATIONAL MONUMENT
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
CRAWFORD COUNTY WISCONSIN
3
10
(Joins sheet 6)
(Joins upper left)
2 620 000 FEET
13
N
1 Mile
5 000 Feet
Scale 1:15 840

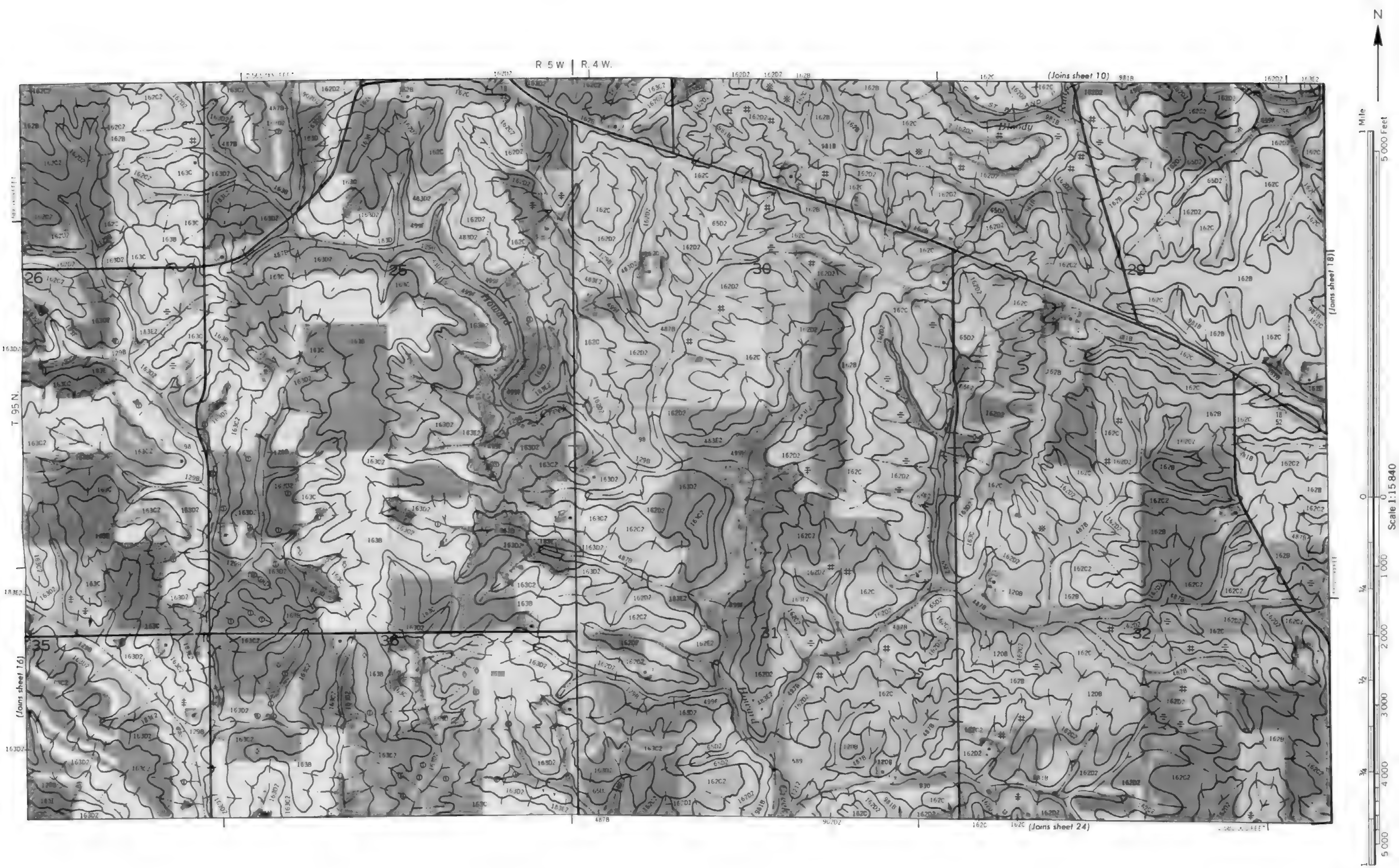
CLAYTON COUNTY, IOWA — SHEET NUMBER 14

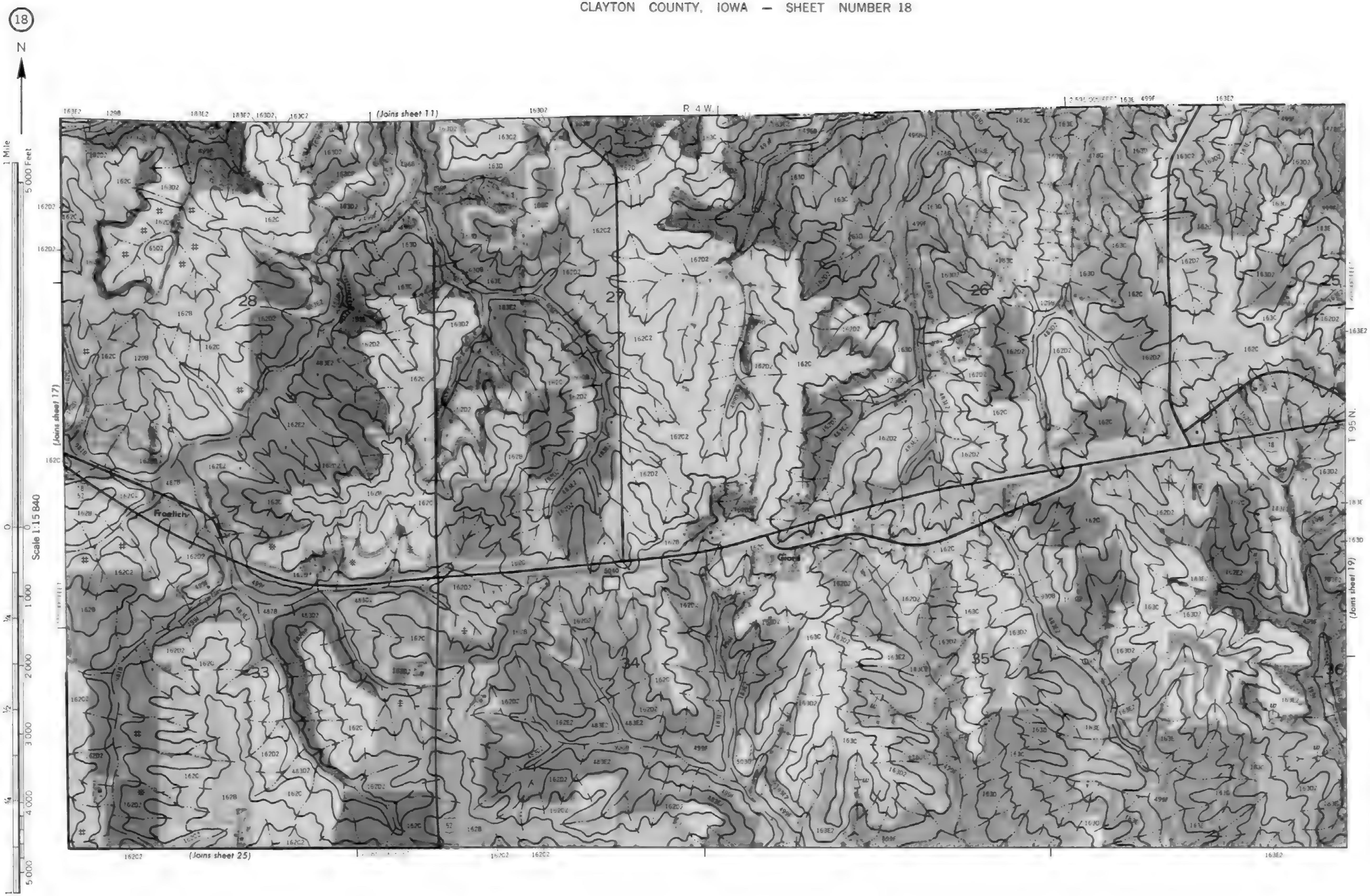



N
R. 6 W
R. 5 W
(Joins sheet 8)
(Joins sheet 16)
(Joins sheet 22)
(Joins sheet 14)
T 95 N.
Roberts Creek
Deer Creek
27
26
25
30
34
35
36
31
1 Mile
5 000 Feet
Scale 1:15 840

CLAYTON COUNTY, IOWA — SHEET NUMBER 16

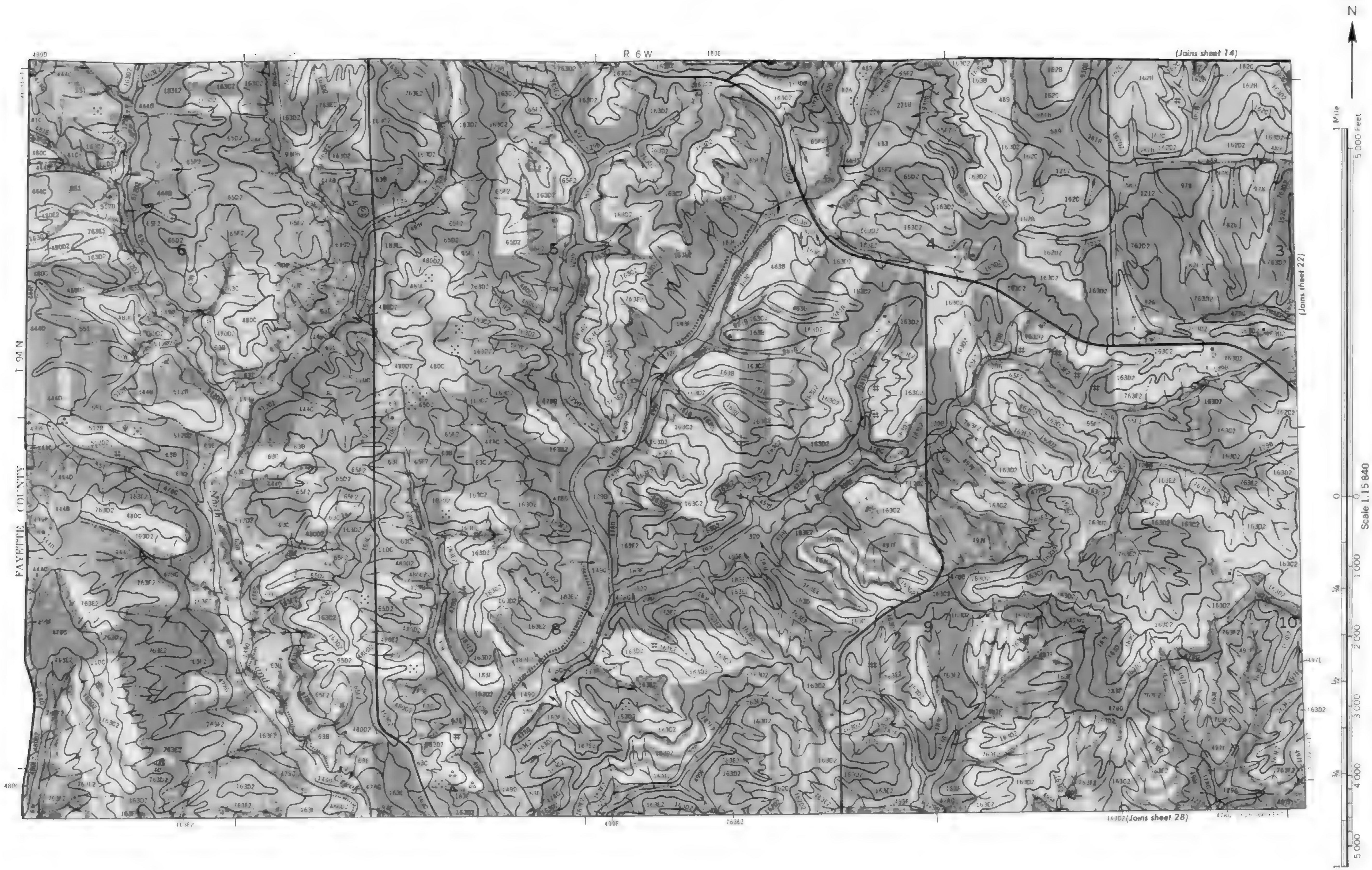


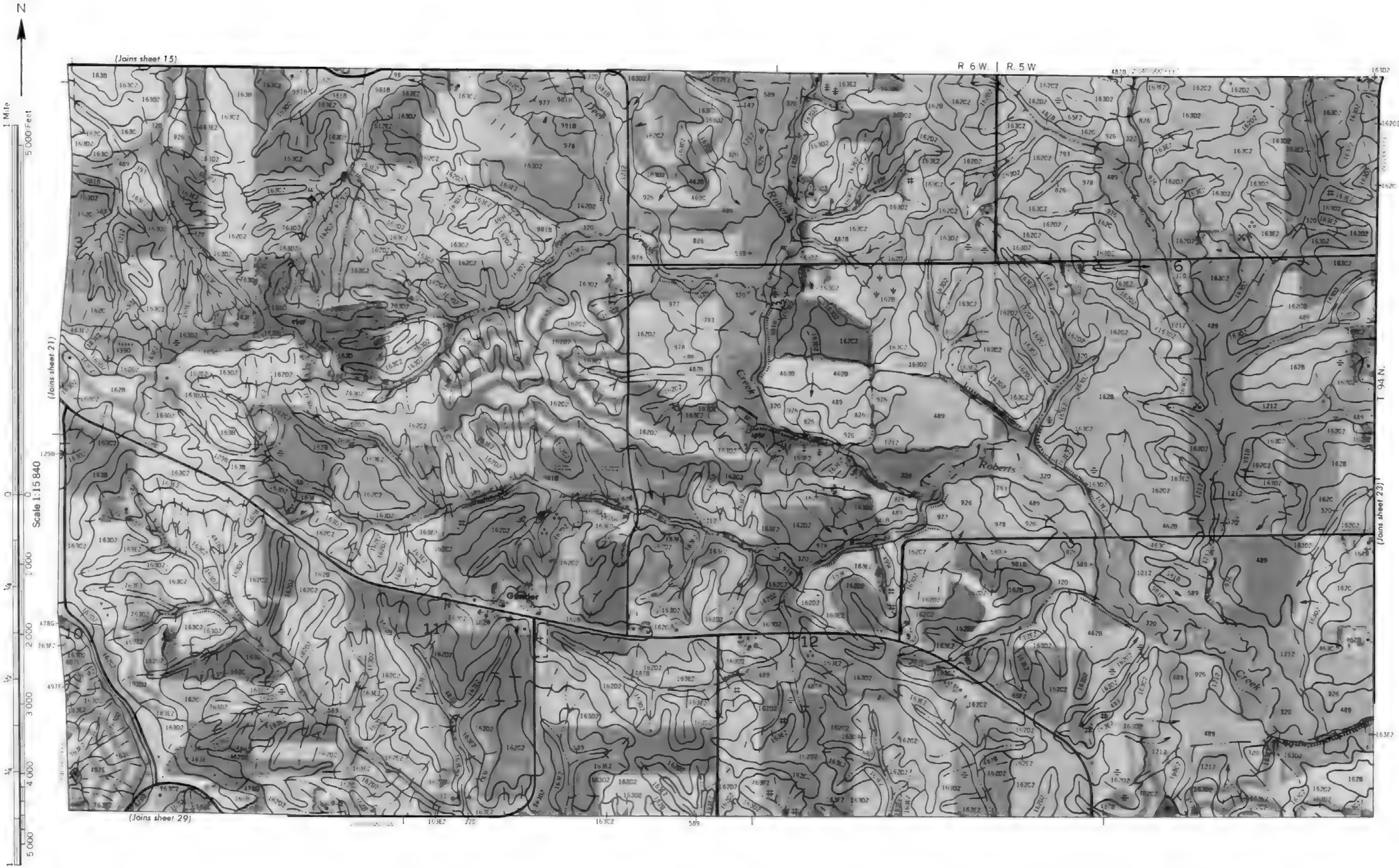

17
N
R. 5 W. | R. 4 W.
(Joins sheet 10)
(Joins sheet 18)
(Joins sheet 24)
(Joins sheet 16)
T. 95 N.
26
25
30
29
35
36
31
32
1 Mile
5 000 Feet
Scale 1:15 840

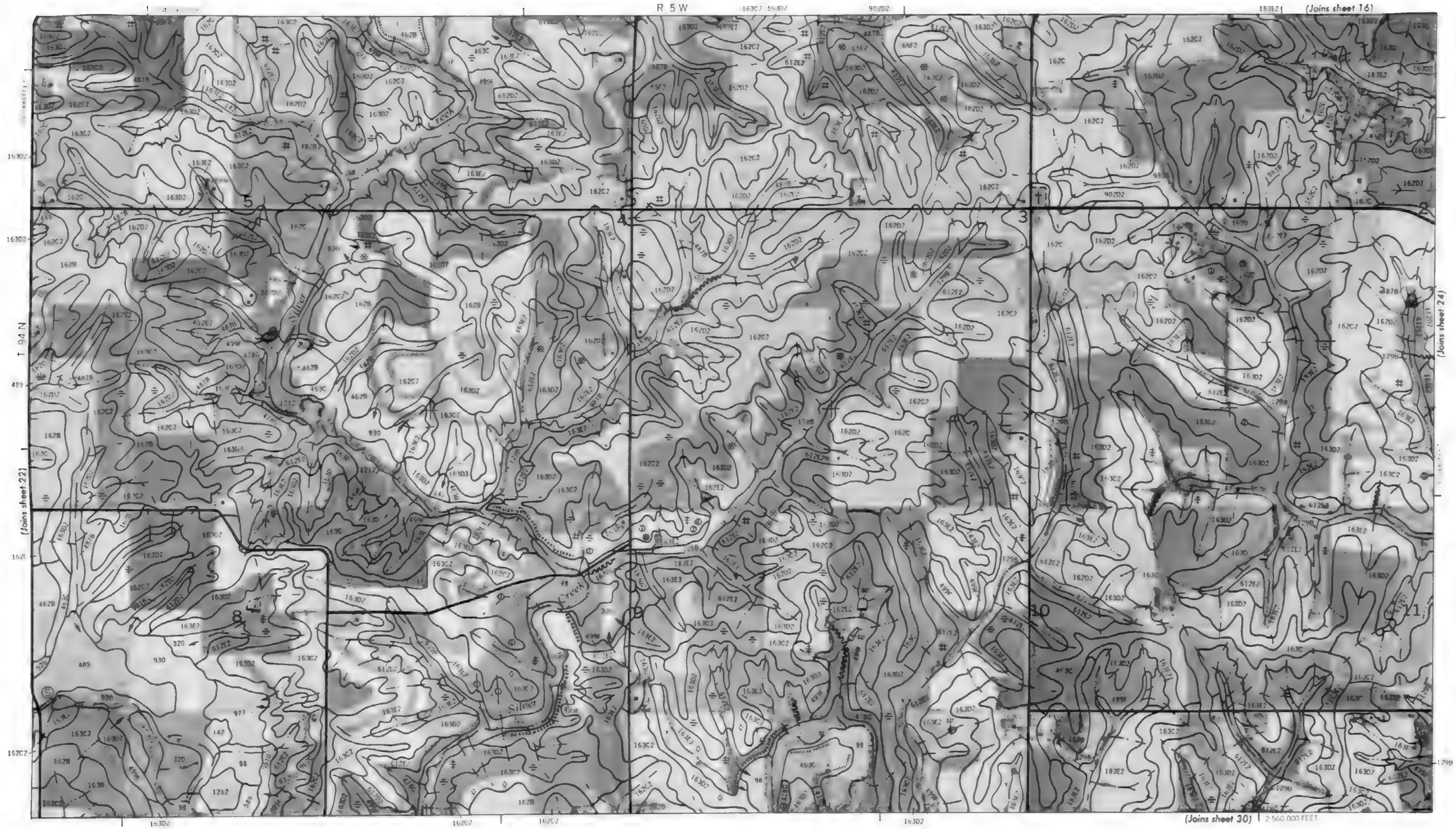

18
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 11)
R 4 W.
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 25)
T 95 N.
Froelich
Giard
28
27
26
25
33
34
35
36

CLAYTON COUNTY, IOWA — SHEET NUMBER 19

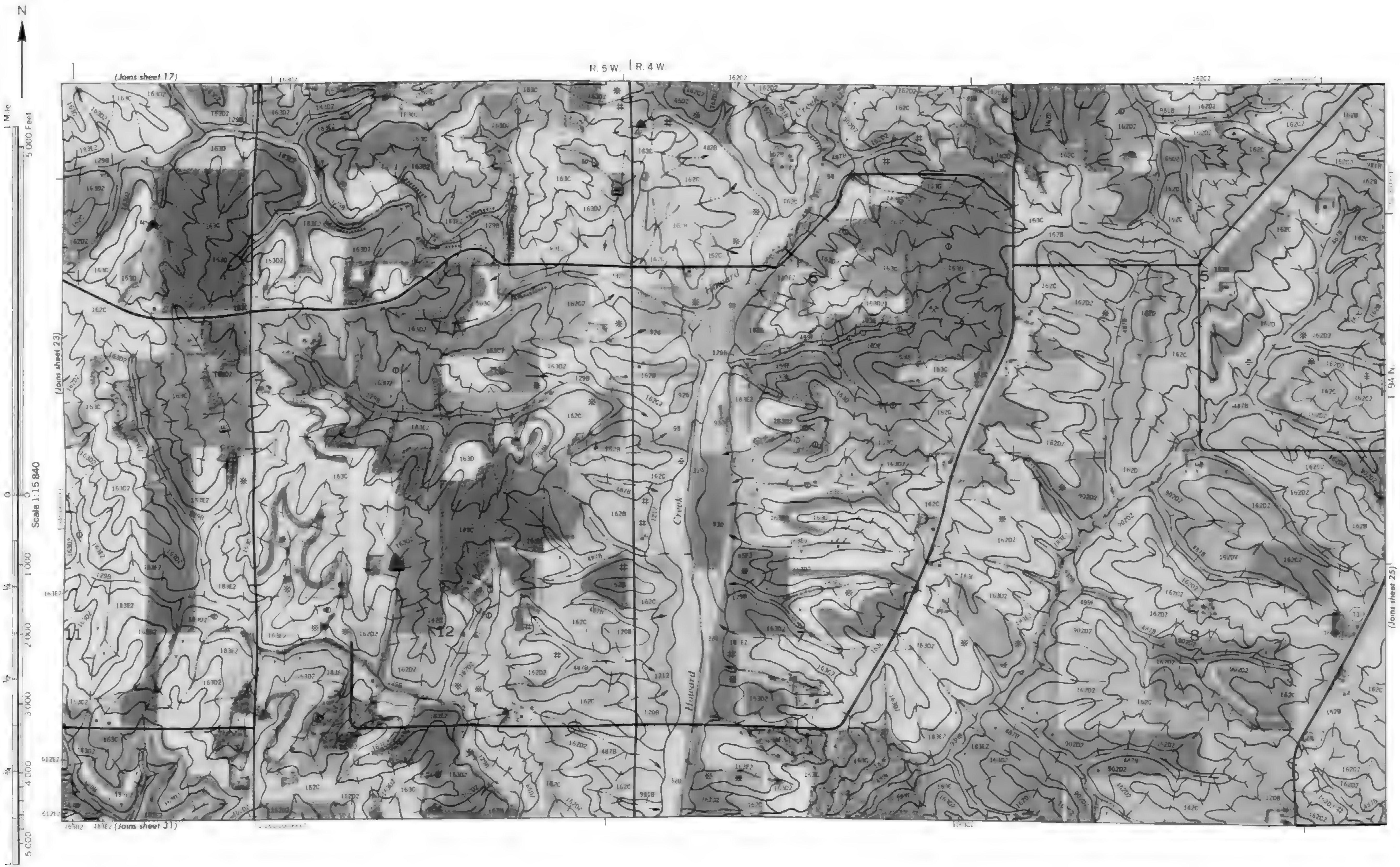

20
N
(Joins sheet 13)
R 3 W
2 635 000 FEET
McGregor
UPPER
MISSISSIPPI
CRAWFORD
COUNTY
RIVER
WISCONSIN
WILDLIFE
AND
FISH
REFUGE
MISSISSIPPI
RIVER
PIKES
PEAK
STATE
PARK
27
26
34
35
T 95 N.
(Joins sheet 19)
(Joins sheet 27)
1 Mile
5 000 Feet
Scale 1:15 840


N
R 6 W
T 94 N
FAYETTE COUNTY
(Joins sheet 14)
(Joins sheet 22)
(Joins sheet 28)
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1
6
5
4
3
7
8
9
10


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 15)
R 6 W. | R. 5 W.
(Joins sheet 21)
T 94 N.
(Joins sheet 23)
(Joins sheet 29)
Roberts
Creek
Gunder
6
7
10
11
12

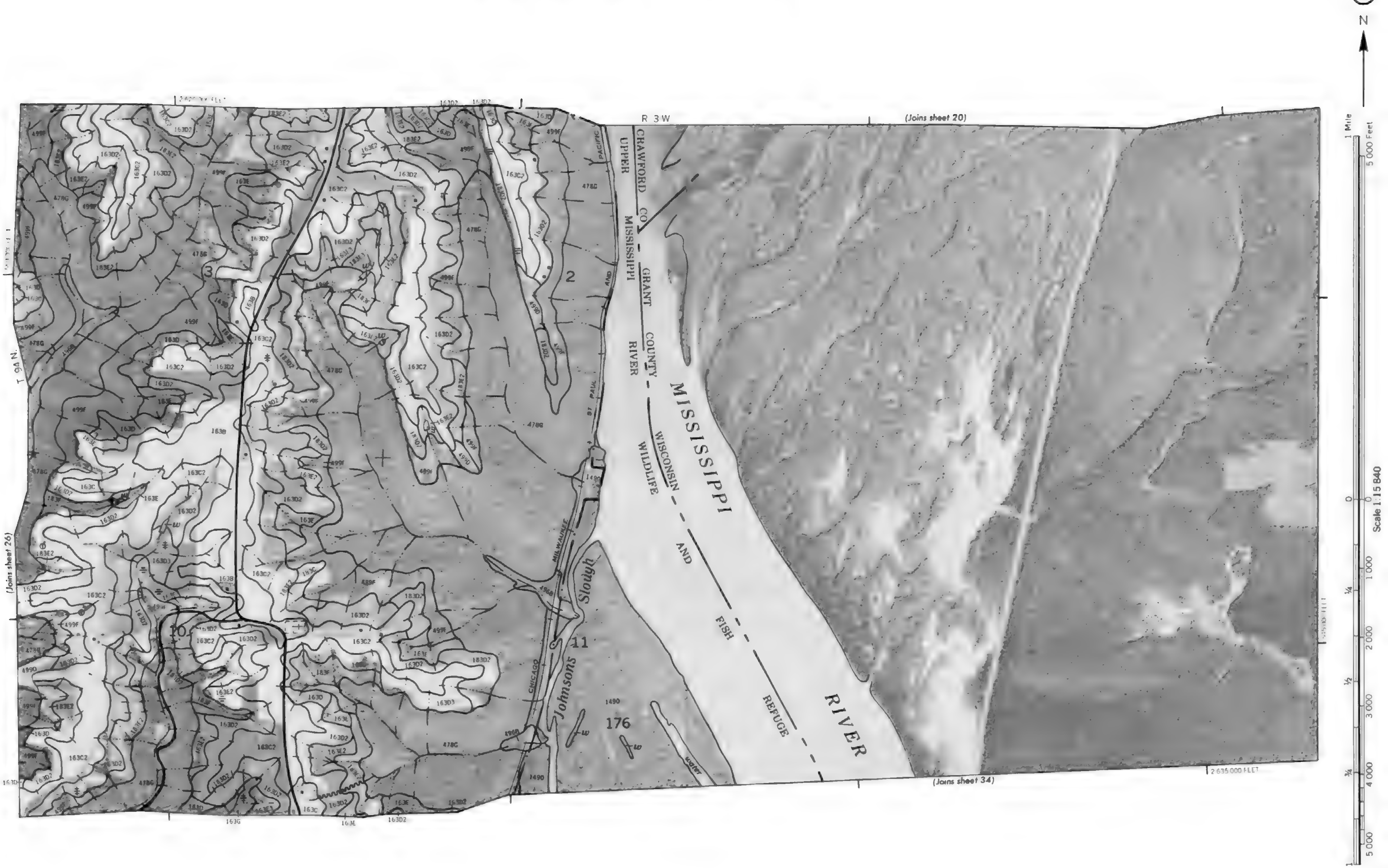

R 5 W
T 94 N
(Joins sheet 16)
(Joins sheet 24)
(Joins sheet 30)
(Joins sheet 22)
Silver Creek
2 560 000 FEET


N
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 17)
R. 5 W.
R. 4 W.
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 31)
T. 94 N.
Howard Creek
5
6
7
8
11
12

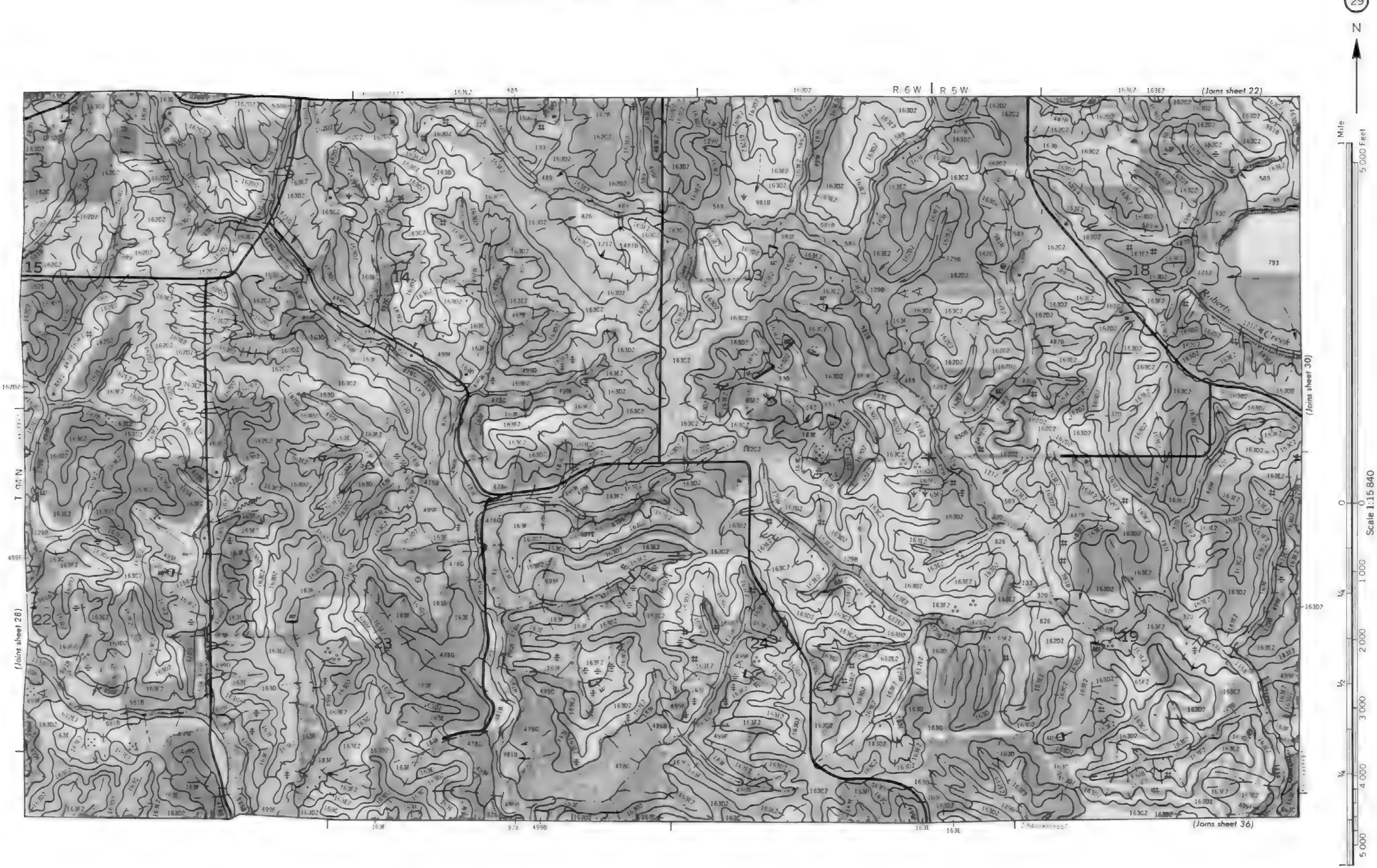

25
N
R. 4 W.
(Joins sheet 18)
(Joins sheet 26)
(Joins sheet 32)
(Joins sheet 24)
T. 94 N.
1 Mile
5 000 Feet
Scale 1:15 840

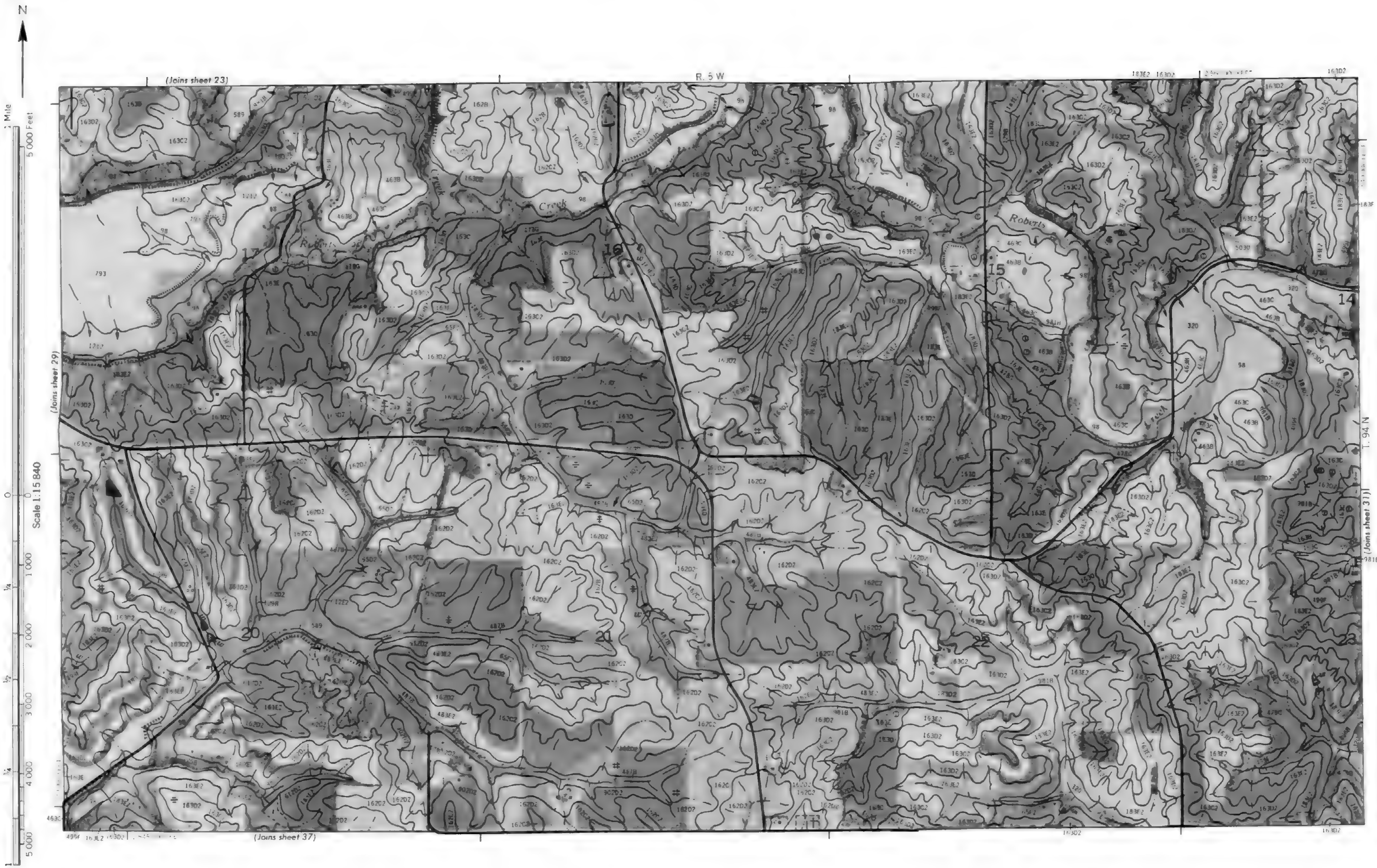

26
N
(Joins sheet 19)
R 4 W
R 3 W
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 33)
T 94 N.
Sny Magill Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000

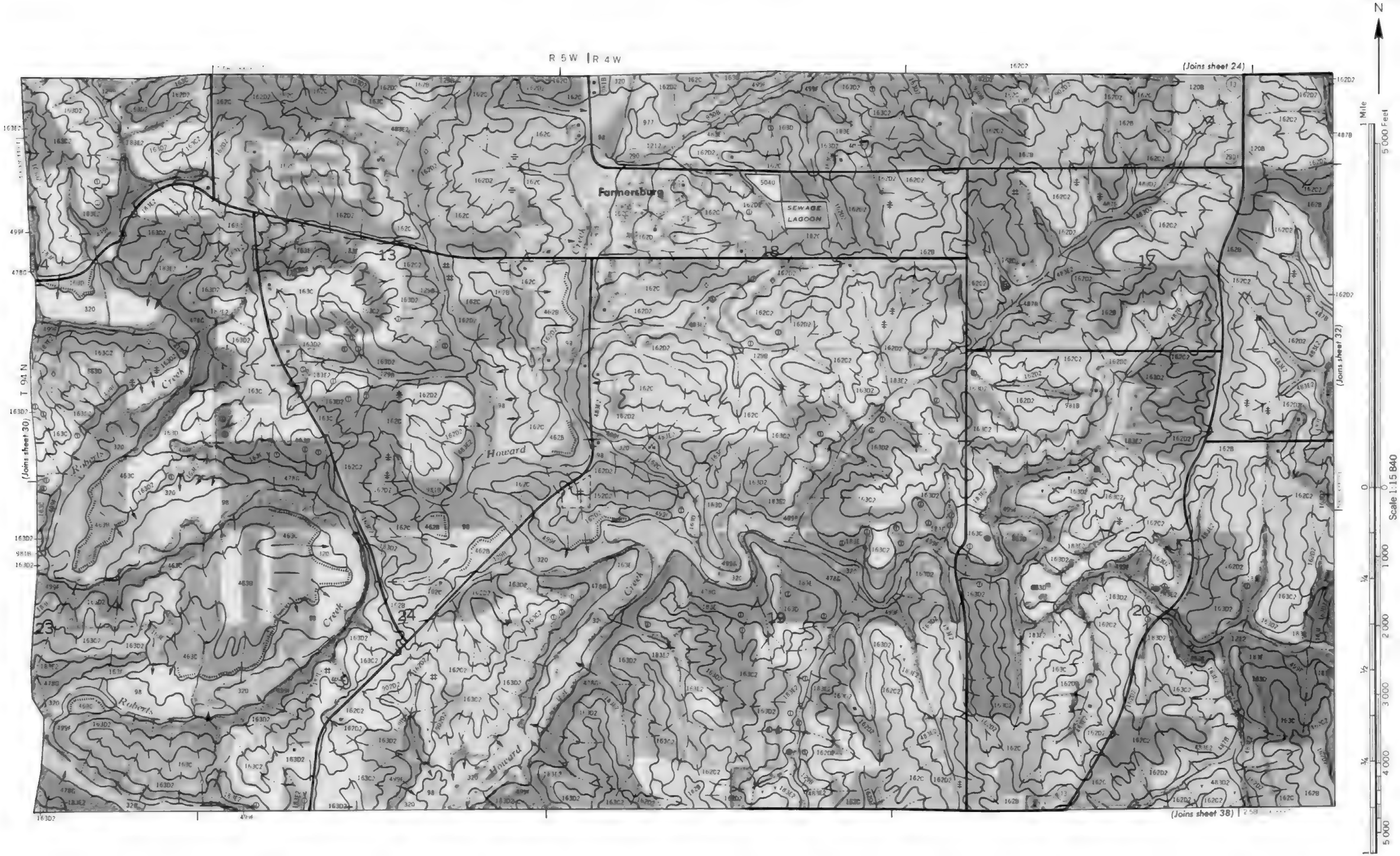

27
N
R 3 W
(Joins sheet 20)
(Joins sheet 26)
(Joins sheet 34)
T 94 N.
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
CRAWFORD CO
GRANT COUNTY
WISCONSIN
MISSISSIPPI
RIVER
Johnsons Slough
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
2 635 000 FEET
2
3
10
11
176
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
0
1

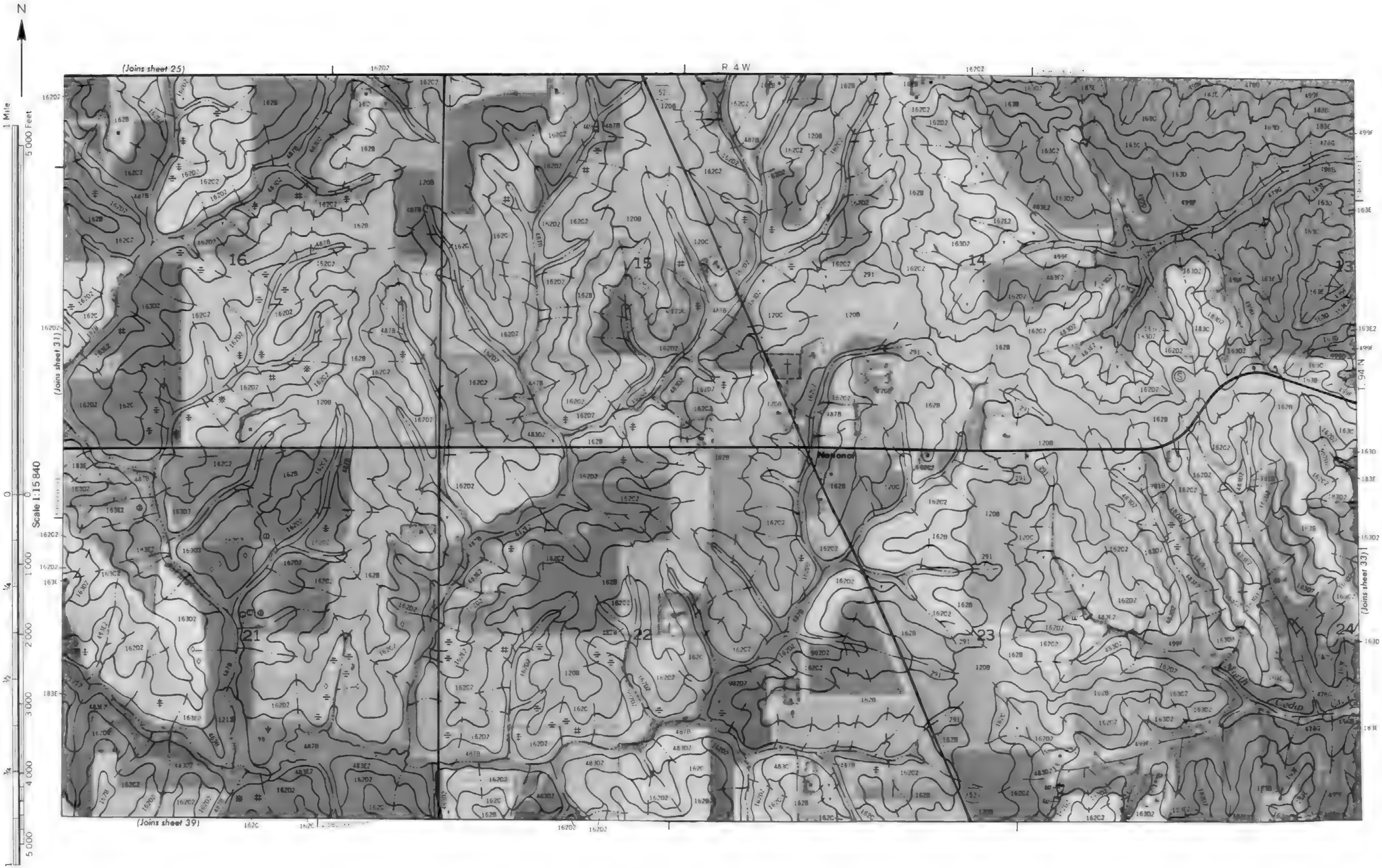

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 21)
R. 6 W.
FAYETTE COUNTY
T. 94 N.
(Joins sheet 29)
(Joins sheet 35)
North Sand Creek
TURKEY RIVER
water
16
17
18
19
20
21
22
15

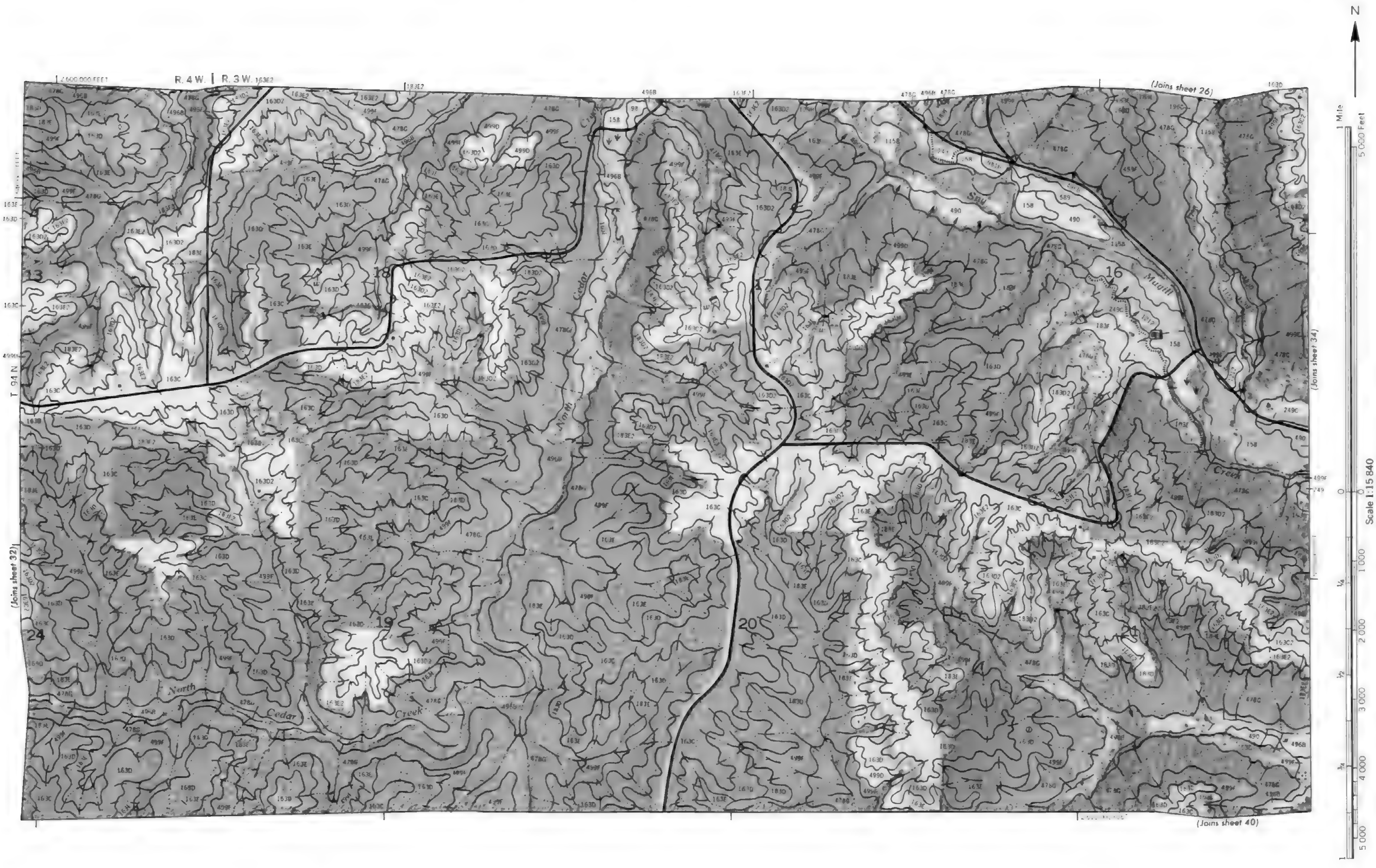
CLAYTON COUNTY, IOWA — SHEET NUMBER 29




N
(Joins sheet 23)
R. 5 W
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 37)
T. 94 N
Scale 1:15 840
1 Mile
5 000 Feet
Roberts
Creek
15
16
17
20
21
22
23

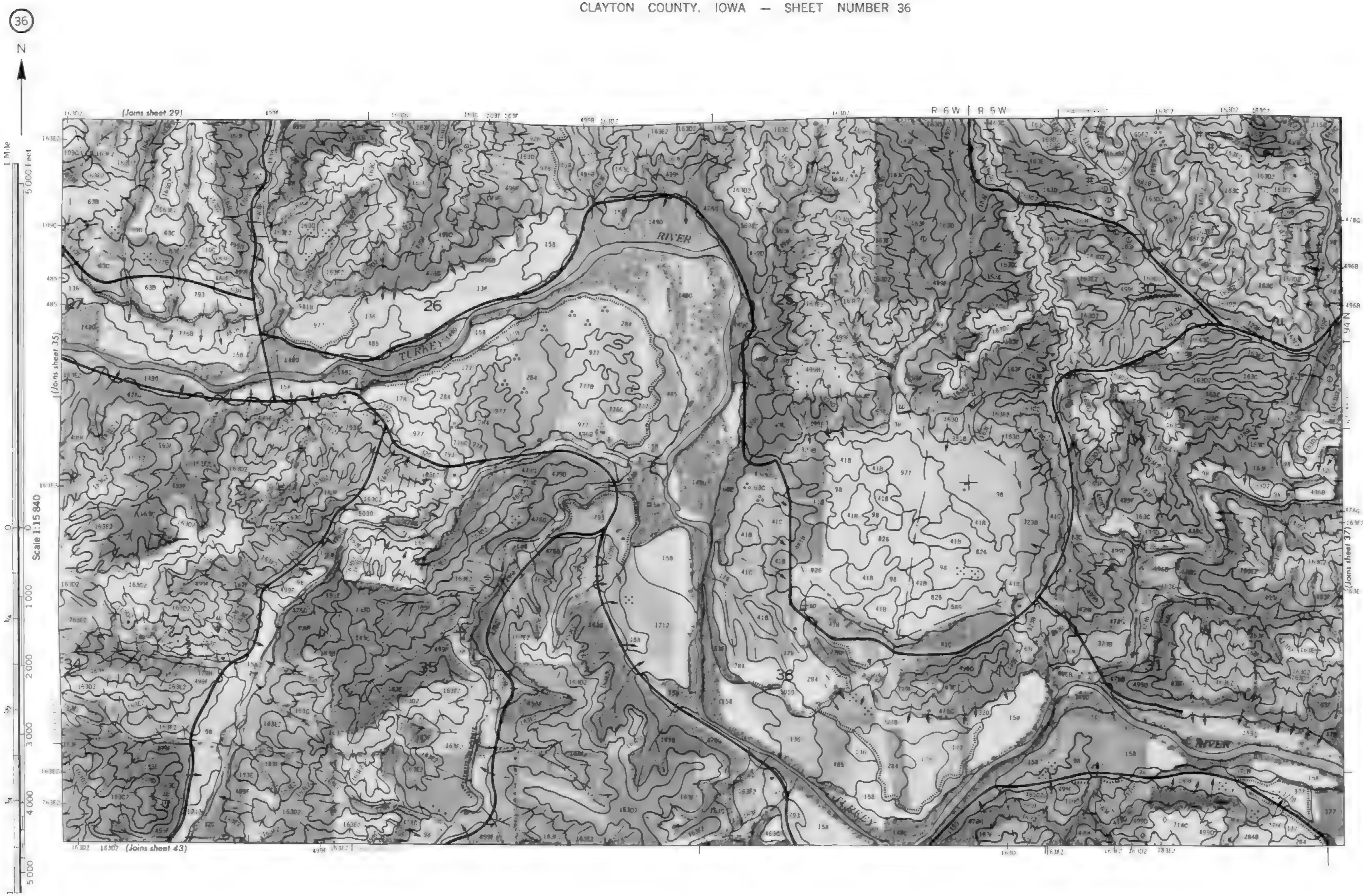

N
R 5 W
R 4 W
(Joins sheet 24)
(Joins sheet 32)
(Joins sheet 30)
(Joins sheet 38)
T 94 N
Farmersburg
SEWAGE
LAGOON
Howard
Creek
Roberts
Creek
13
18
17
24
19
20
23
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 25)
R 4 W
(Joins sheet 31)
(Joins sheet 33)
(Joins sheet 39)
T. 94 N.
National
North Cedar Cr.
16
15
14
13
21
22
23
24

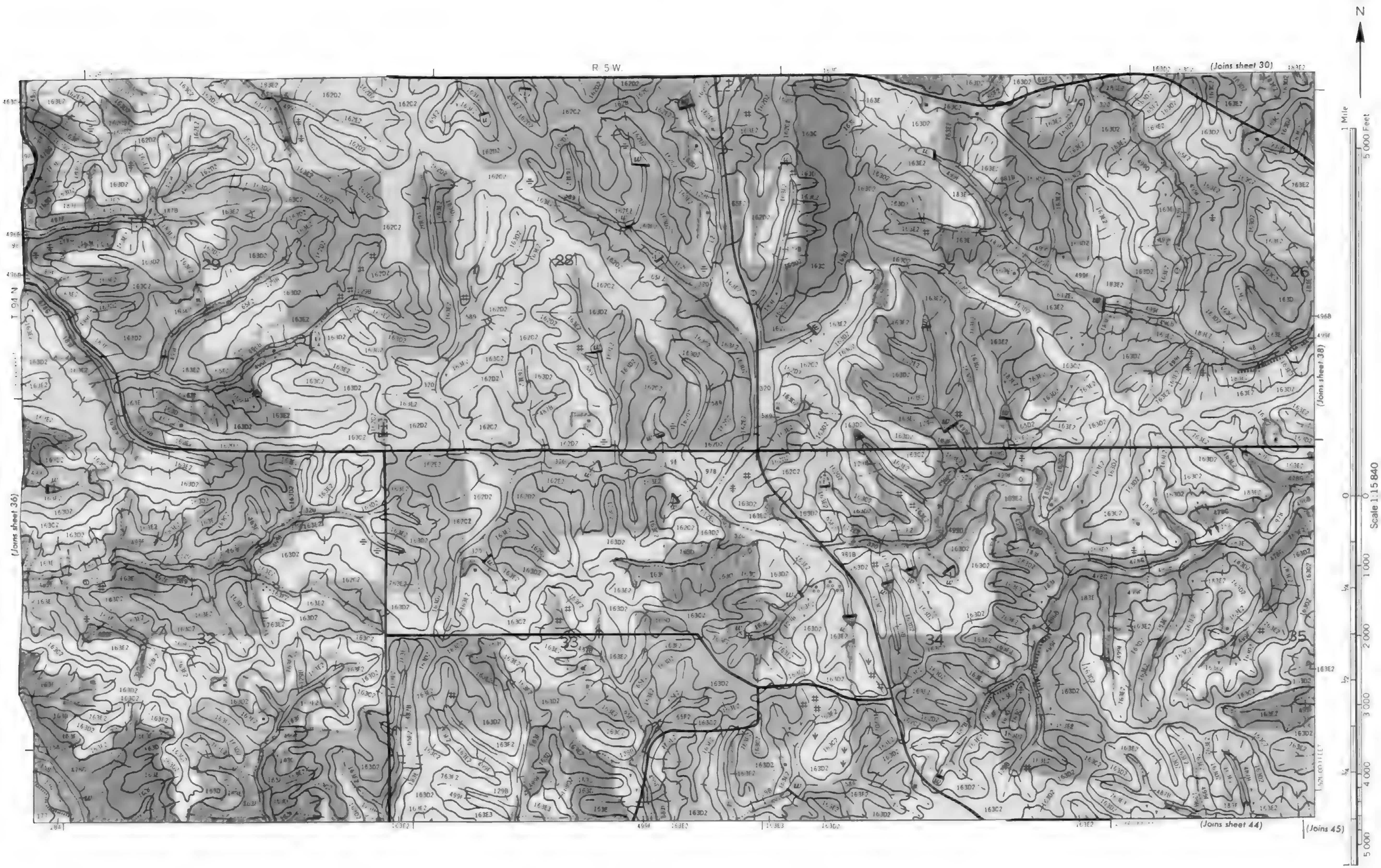

N
R. 4 W.
R. 3 W.
T. 94 N.
(Joins sheet 26)
(Joins sheet 34)
(Joins sheet 40)
(Joins sheet 32)
North Cedar Creek
Creek
13
16
18
19
20
21
24
Scale 1:15 840
1 Mile
5 000 Feet


34
N
(Joins sheet 27)
R 3 W
(Joins sheet 33)
(Joins sheet 41)
Scale 1:15 840
1 Mile
5 000 Feet
Johnsons Slough
Island 176
water
14
15
22
23
EFFIGY
MOUNDS
NATIONAL
MONUMENT
CHICAGO MILWAUKEE ST PAUL AND PACIFIC
Wyalusing Island
Slough
178
GRANT COUNTY
WISCONSIN
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
MISSISSIPPI RIVER
T 94 N
Creek
1490
478G
163D2
158
490

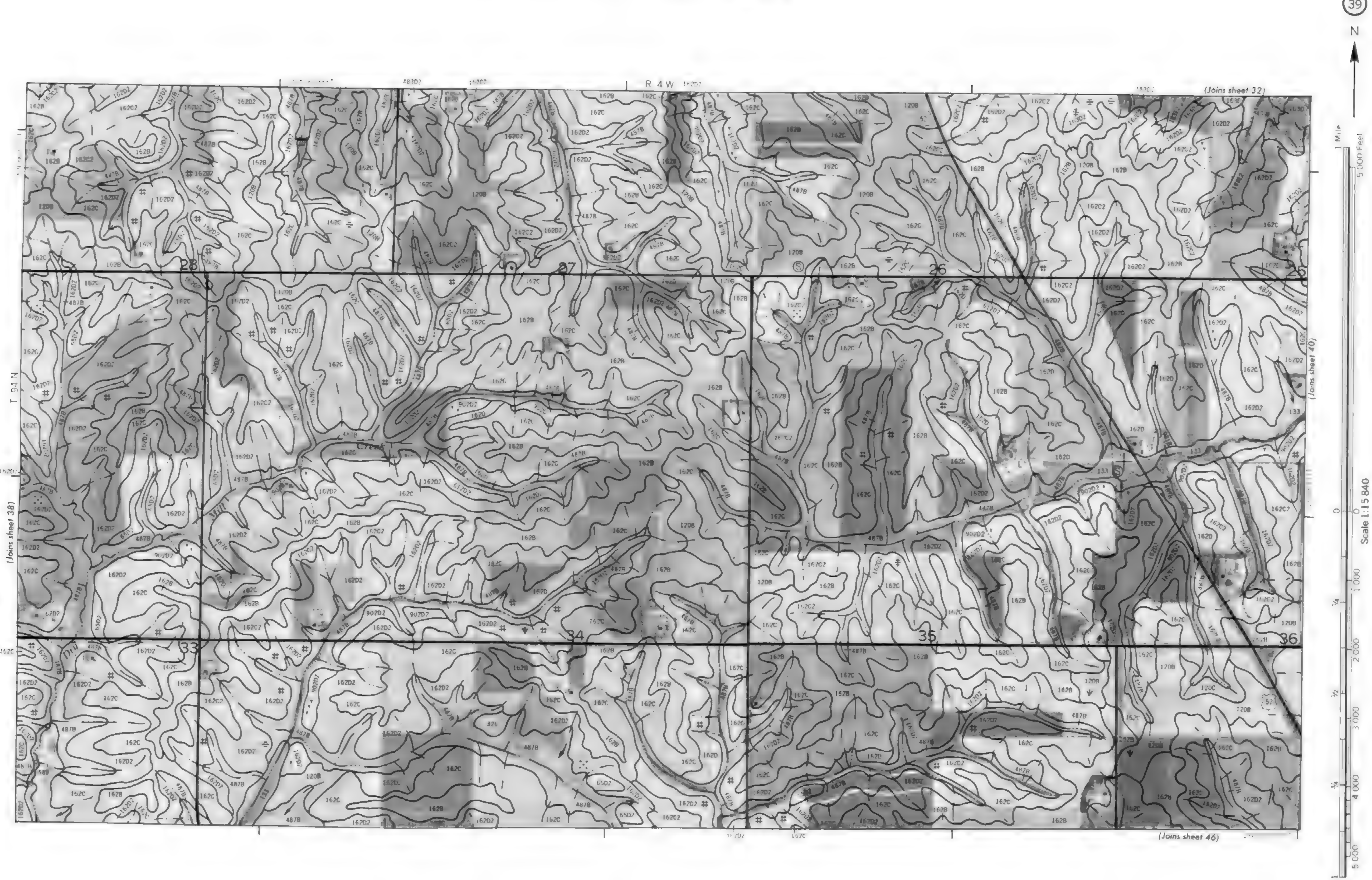

N
R 6 W
(Joins sheet 28)
(Joins sheet 36)
(Joins sheet 42)
T 94 N
FAYETTE COUNTY
RIVER
1 Mile
5 000 Feet
Scale 1:15 840

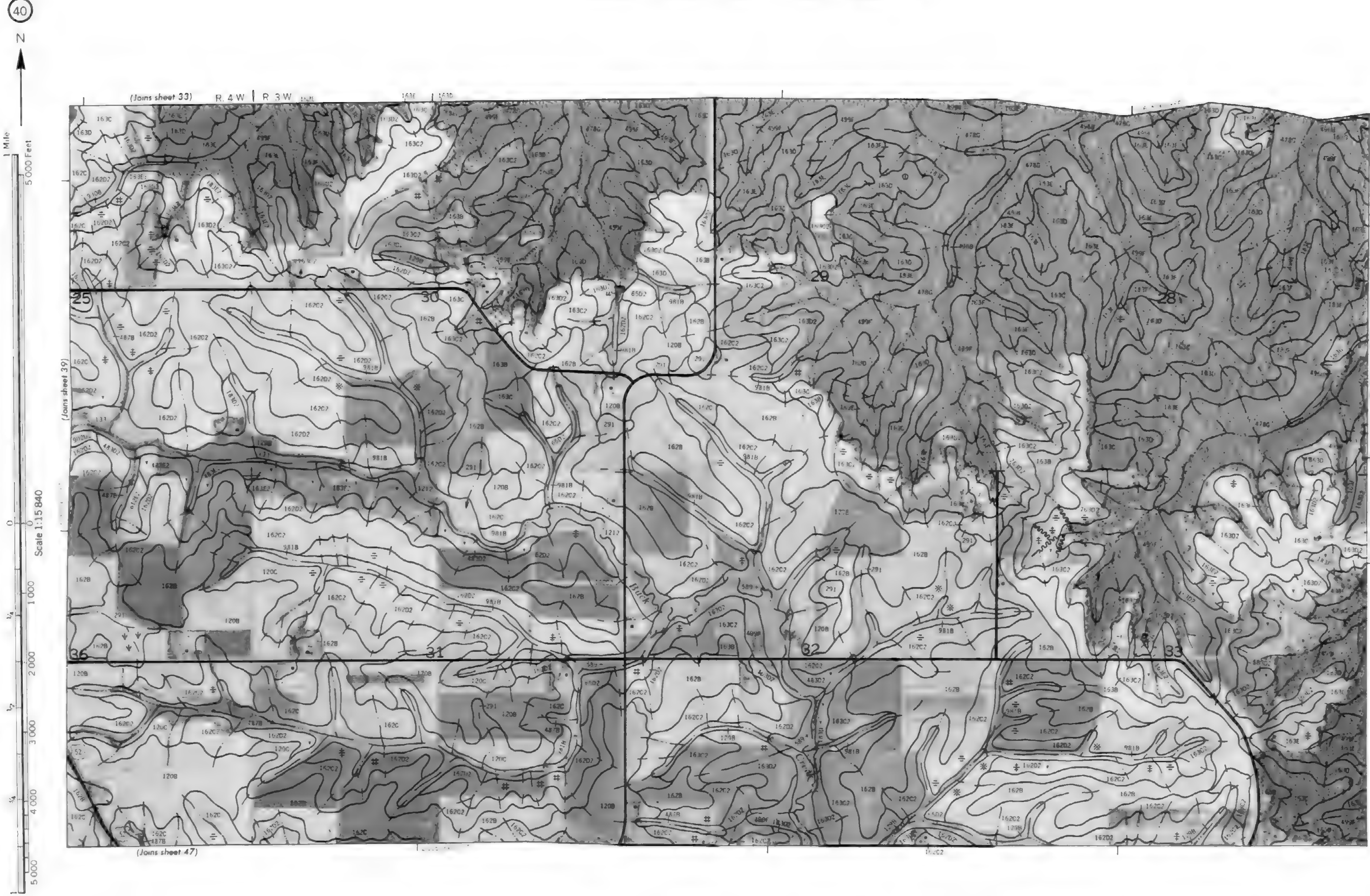


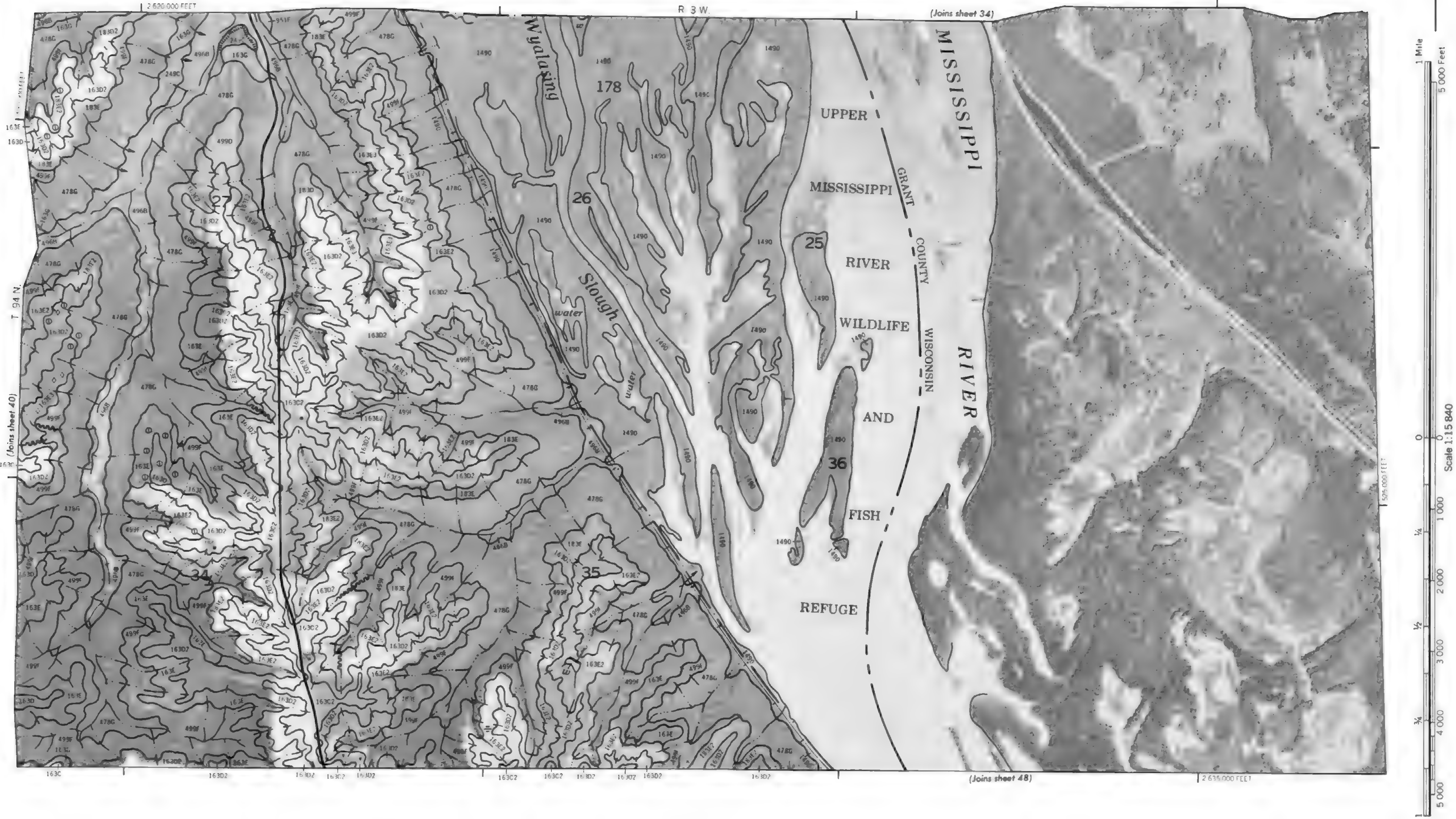
36
N
(Joins sheet 29)
(Joins sheet 35)
(Joins sheet 43)
(Joins sheet 37)
R 6 W
R 5 W
94 N
TURKEY
RIVER
1 Mile
5 000 Feet
Scale 1:15 840

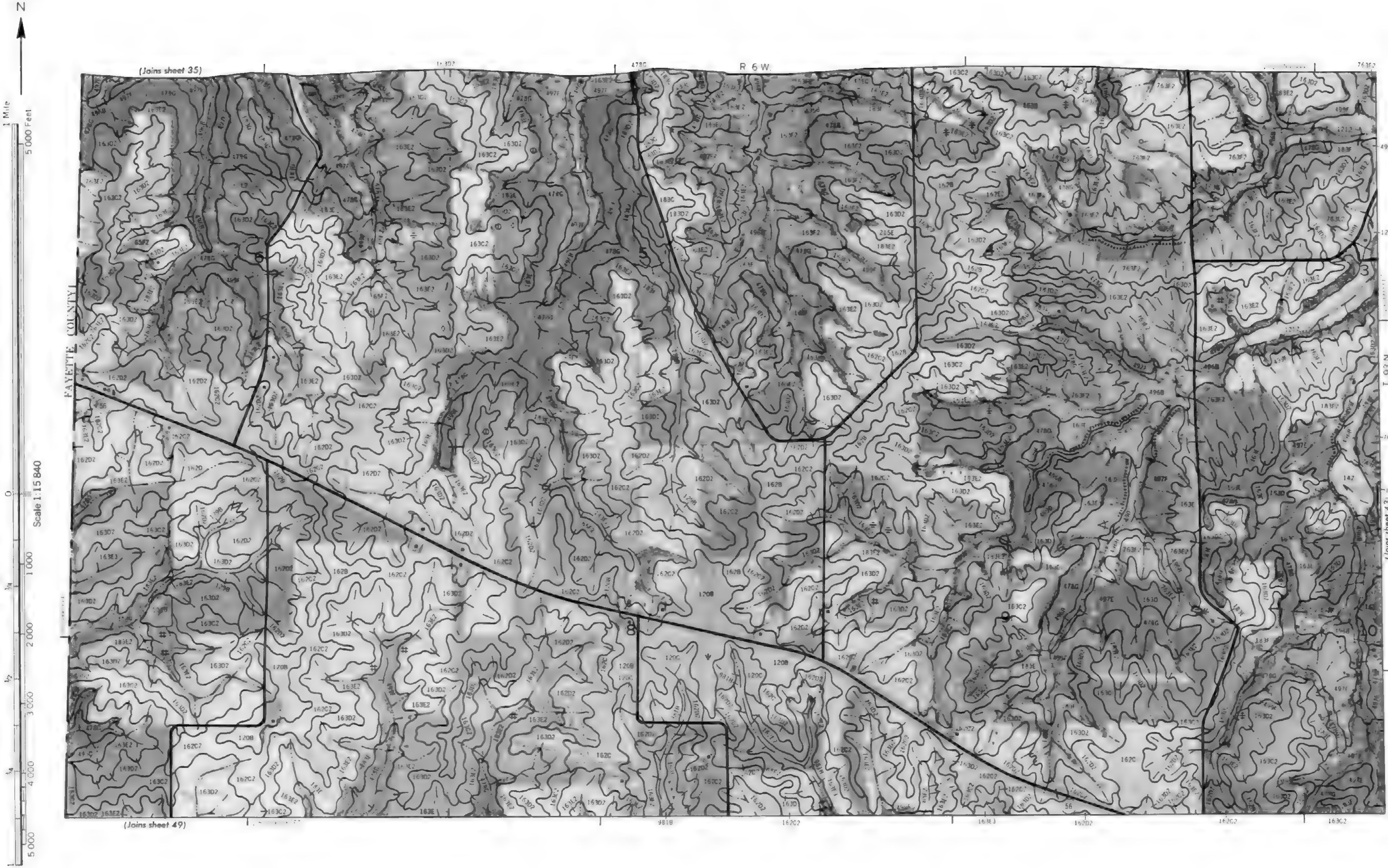

N
R 5 W.
(Joins sheet 30)
(Joins sheet 38)
(Joins sheet 36)
(Joins sheet 44)
(Joins 45)
T 94 N
29
28
27
26
32
33
34
35
1 Mile
5 000 Feet
Scale 1:15 840

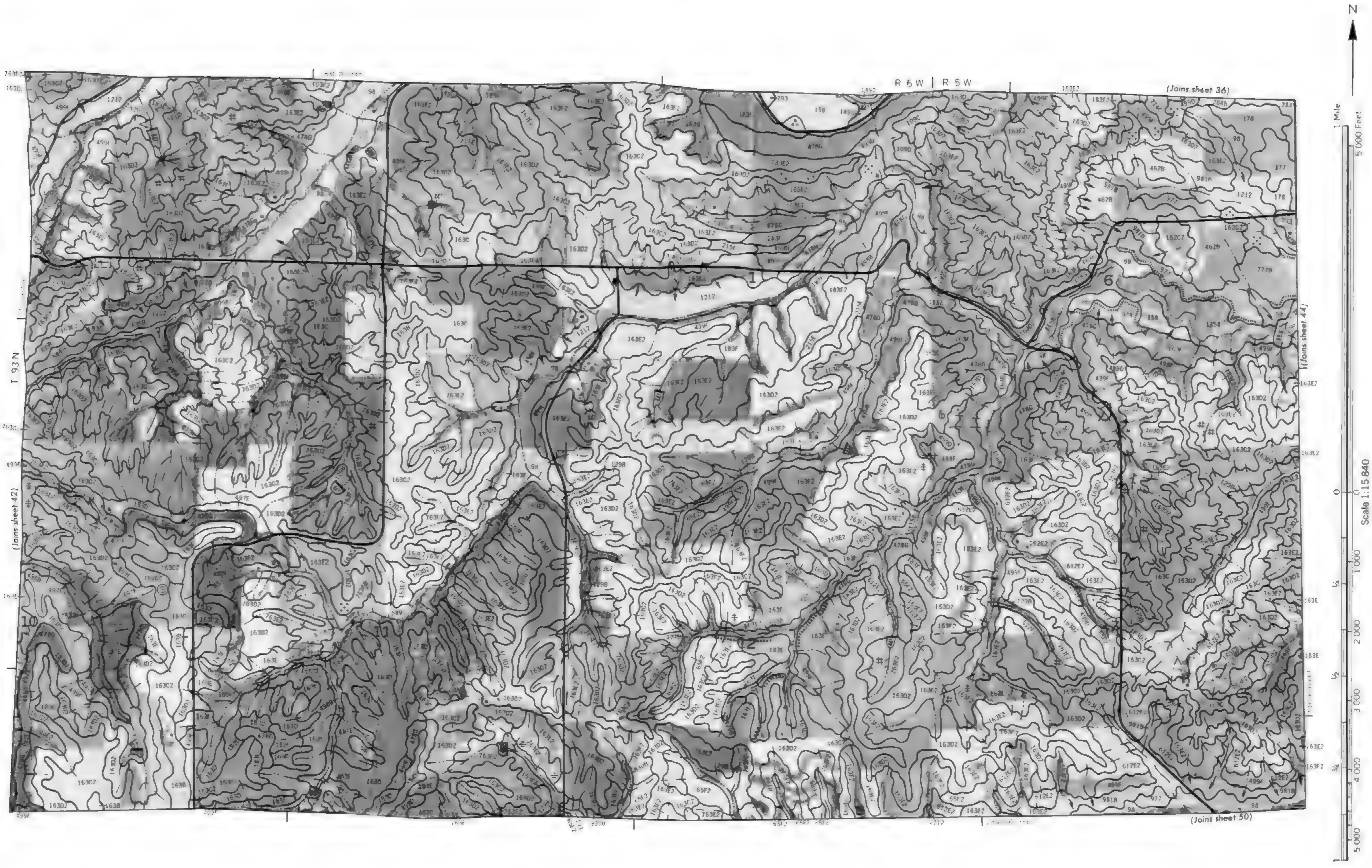

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 31)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 45)
R 5 W
R 4 W
T 94 N
St. Olaf
Roberts
Howard
Creek
Water
25
26
29
30
31
32
35
36

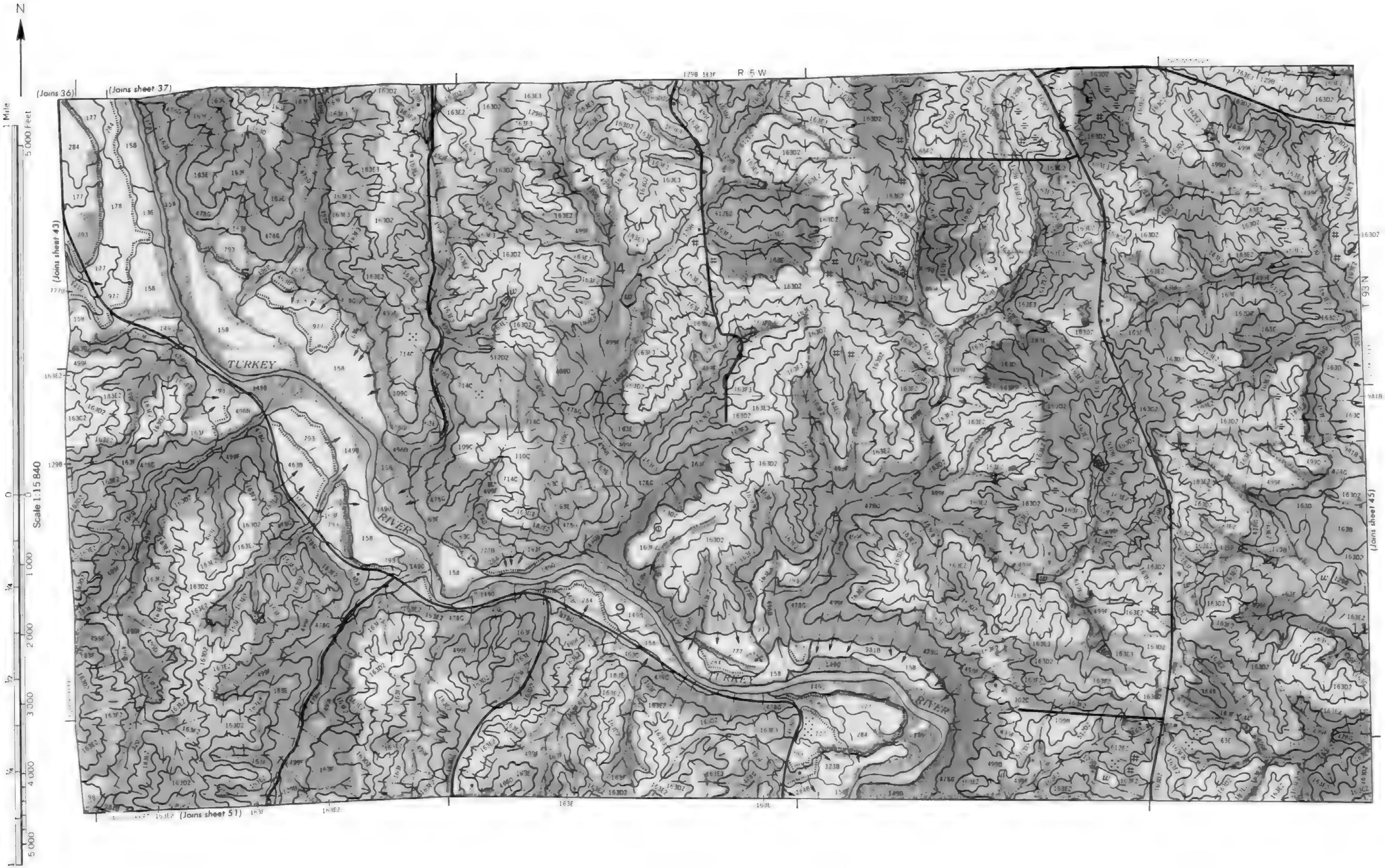

39
N
R 4 W
T 94 N
(Joins sheet 32)
(Joins sheet 40)
(Joins sheet 38)
(Joins sheet 46)
28
27
26
25
33
34
35
36
Mill
Creek
1 Mile
5 000 Feet
Scale 1:15 840


40
N
(Joins sheet 33)
R. 4 W.
R. 3 W.
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 47)
T. 94 N.
25
30
29
28
36
31
32
33
Buck
Creek
1 Mile
5 000 Feet
Scale 1:15 840

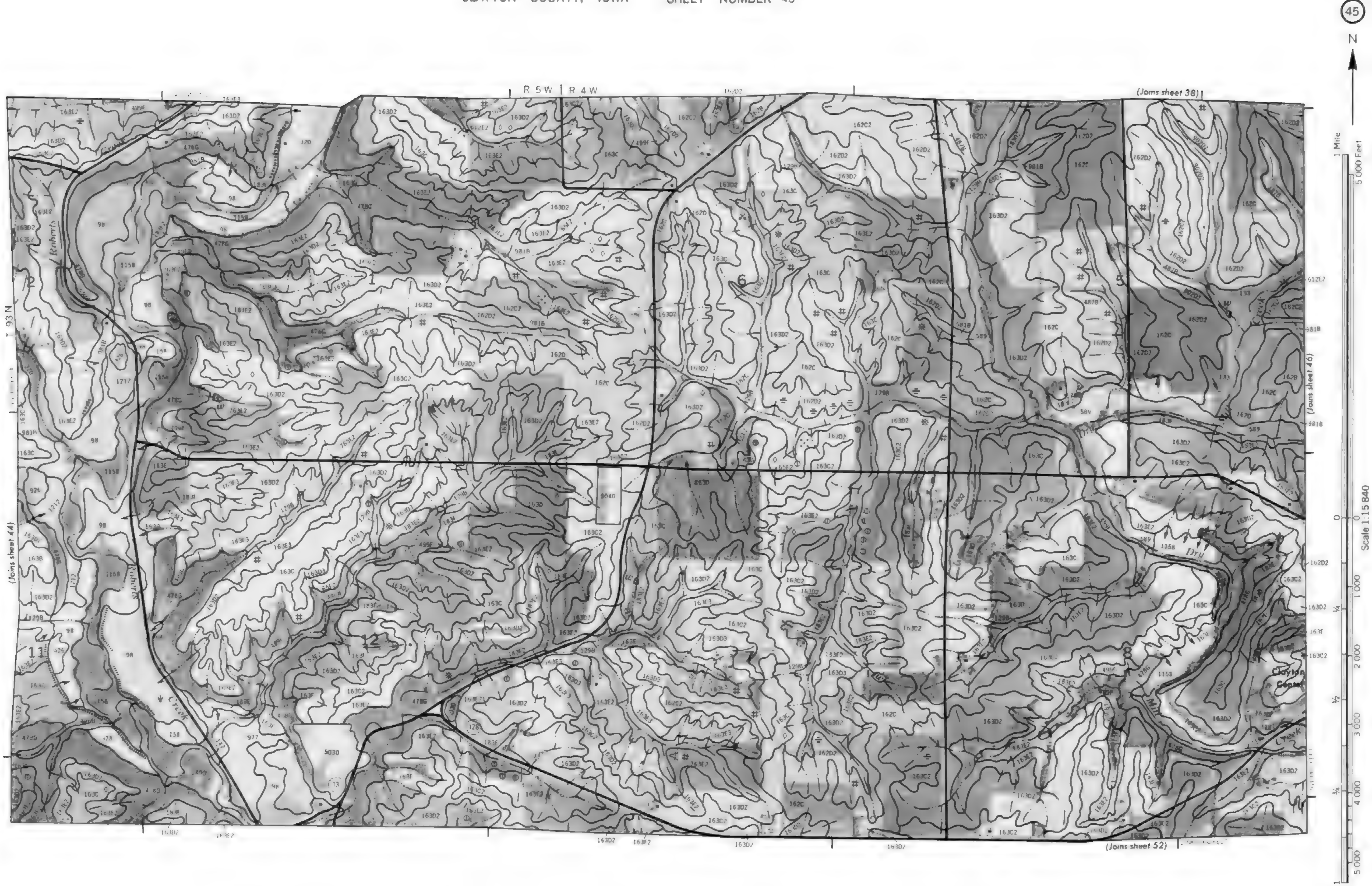

41
N
(Joins sheet 34)
(Joins sheet 40)
(Joins sheet 48)
R 3 W.
T 94 N.
2 620 000 FEET
2 635 000 FEET
Wyalusing
Slough
water
UPPER
MISSISSIPPI
RIVER
WILDLIFE
AND
FISH
REFUGE
MISSISSIPPI
RIVER
GRANT
COUNTY
WISCONSIN
178
26
27
25
36
34
35
1 Mile
5 000 Feet
Scale 1:15 840

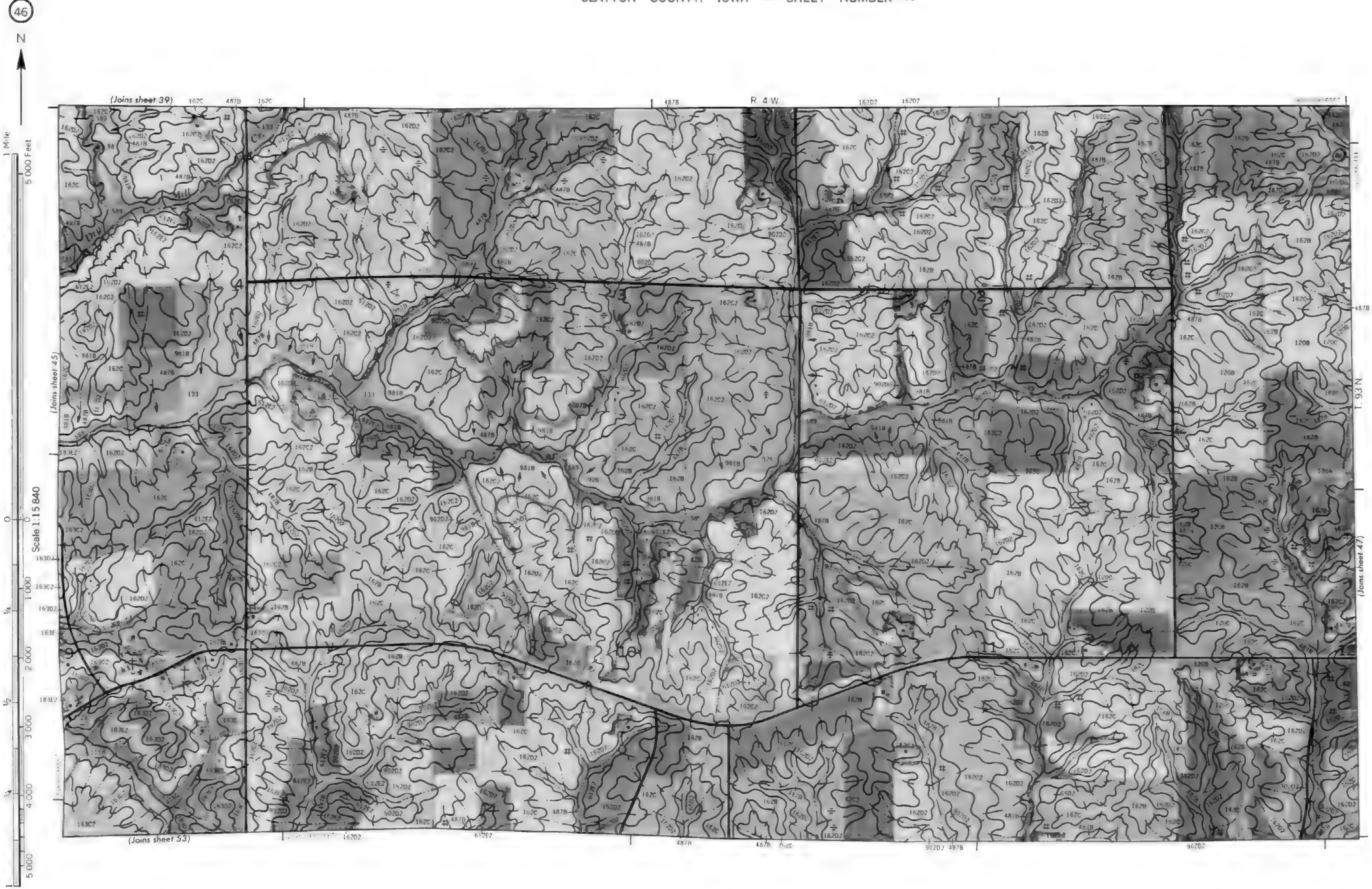

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 35)
R. 6 W.
T. 93 N.
(Joins sheet 43)
(Joins sheet 49)
FAYETTE COUNTY

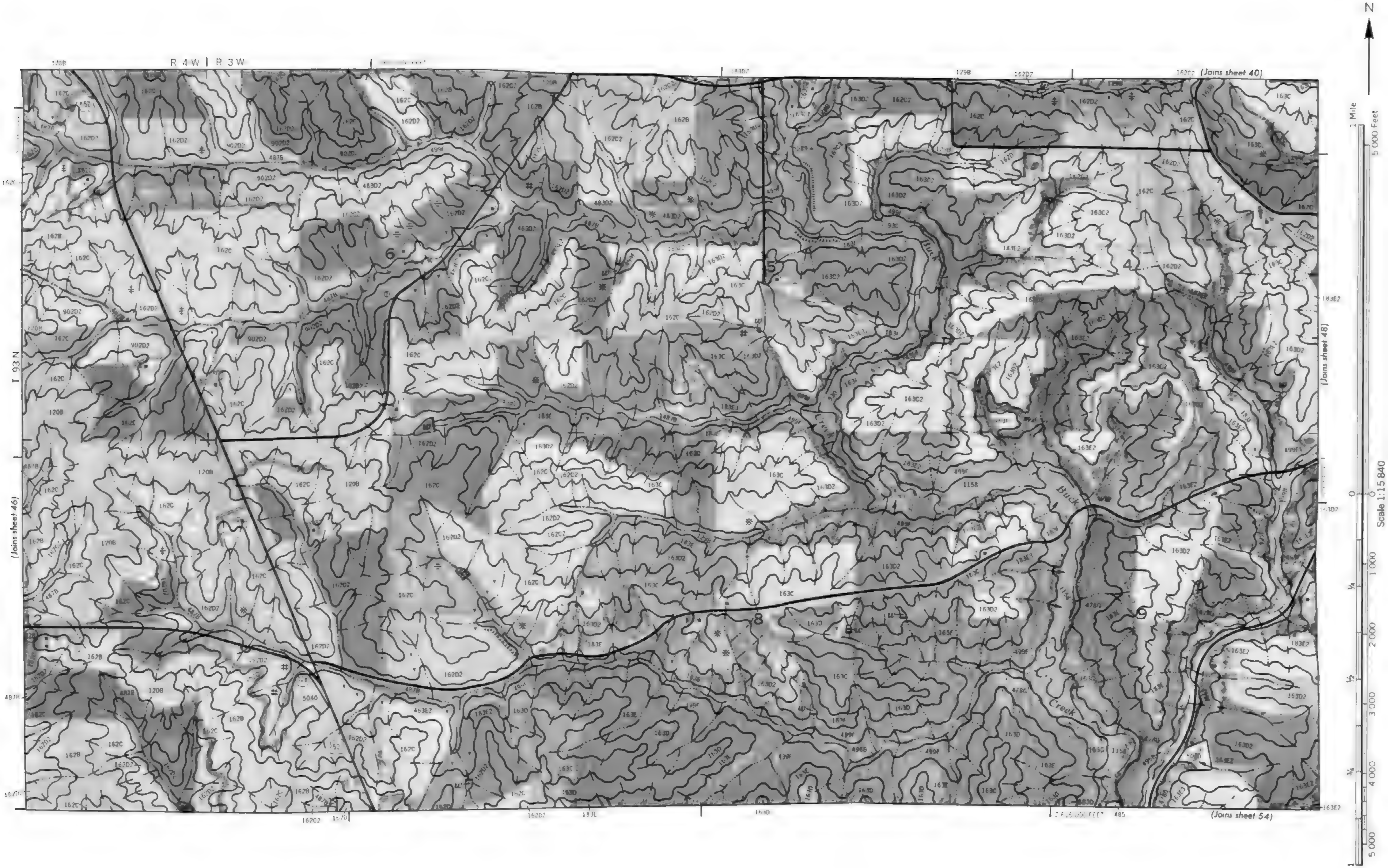

43
N
(Joins sheet 36)
R 6 W | R 5 W
T 93 N
(Joins sheet 42)
(Joins sheet 44)
(Joins sheet 50)
1 Mile
5 000 Feet
Scale 1:15 840

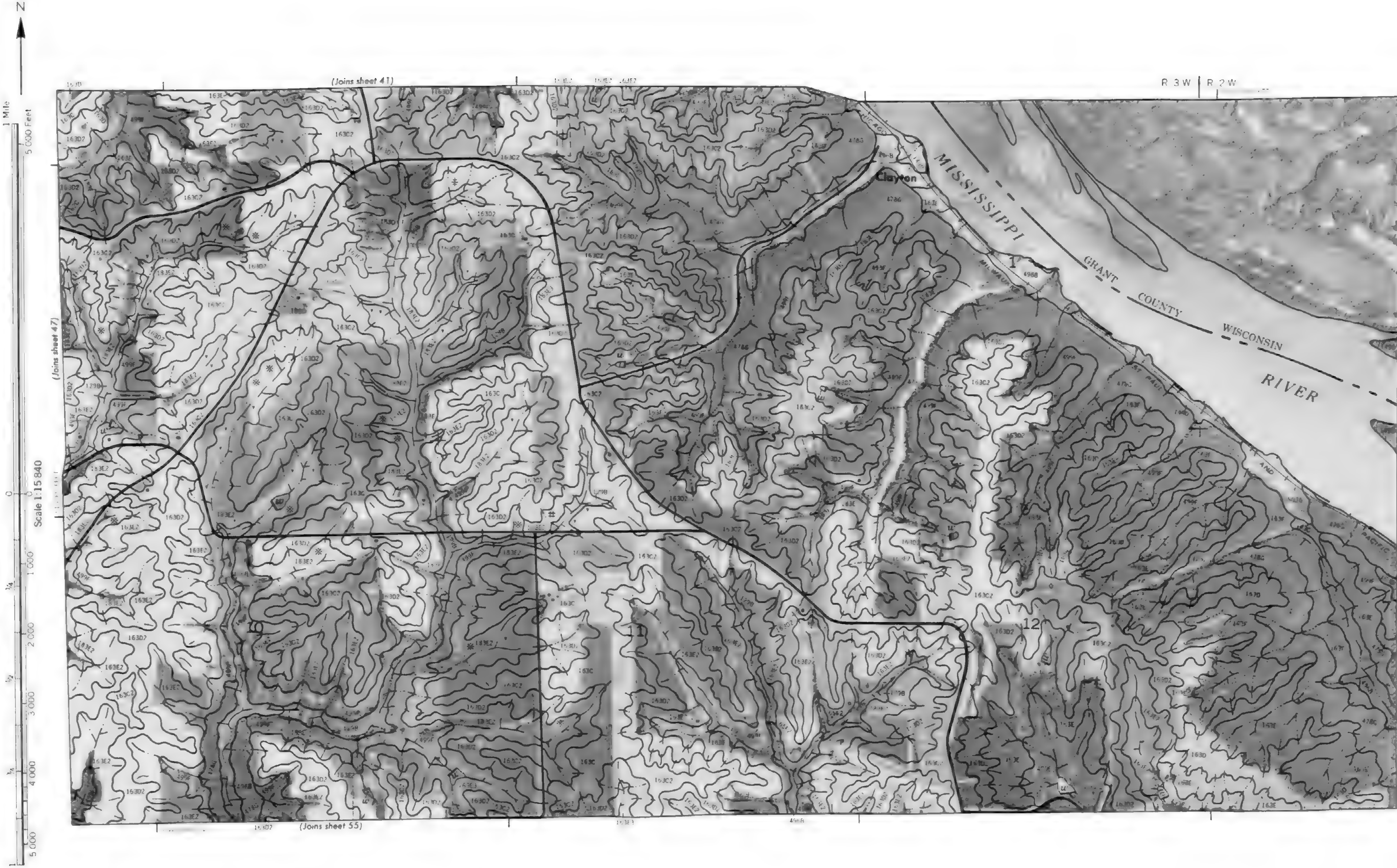

N
(Joins 36)
(Joins sheet 37)
R 5 W
(Joins sheet 43)
(Joins sheet 45)
(Joins sheet 51)
T 93 N
TURKEY
RIVER
1 Mile
5 000 Feet
Scale 1:15 840
0

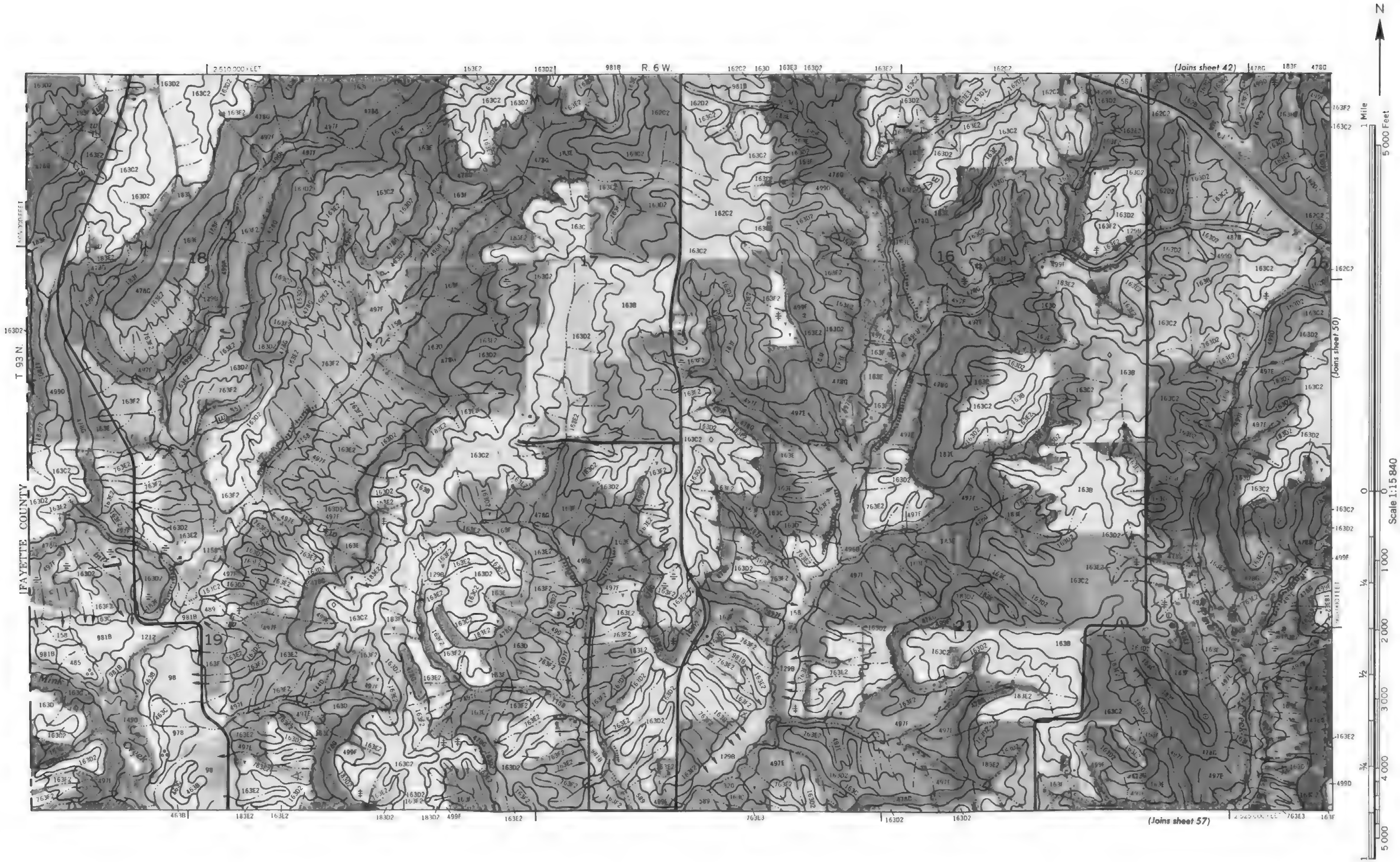
CLAYTON COUNTY, IOWA — SHEET NUMBER 45



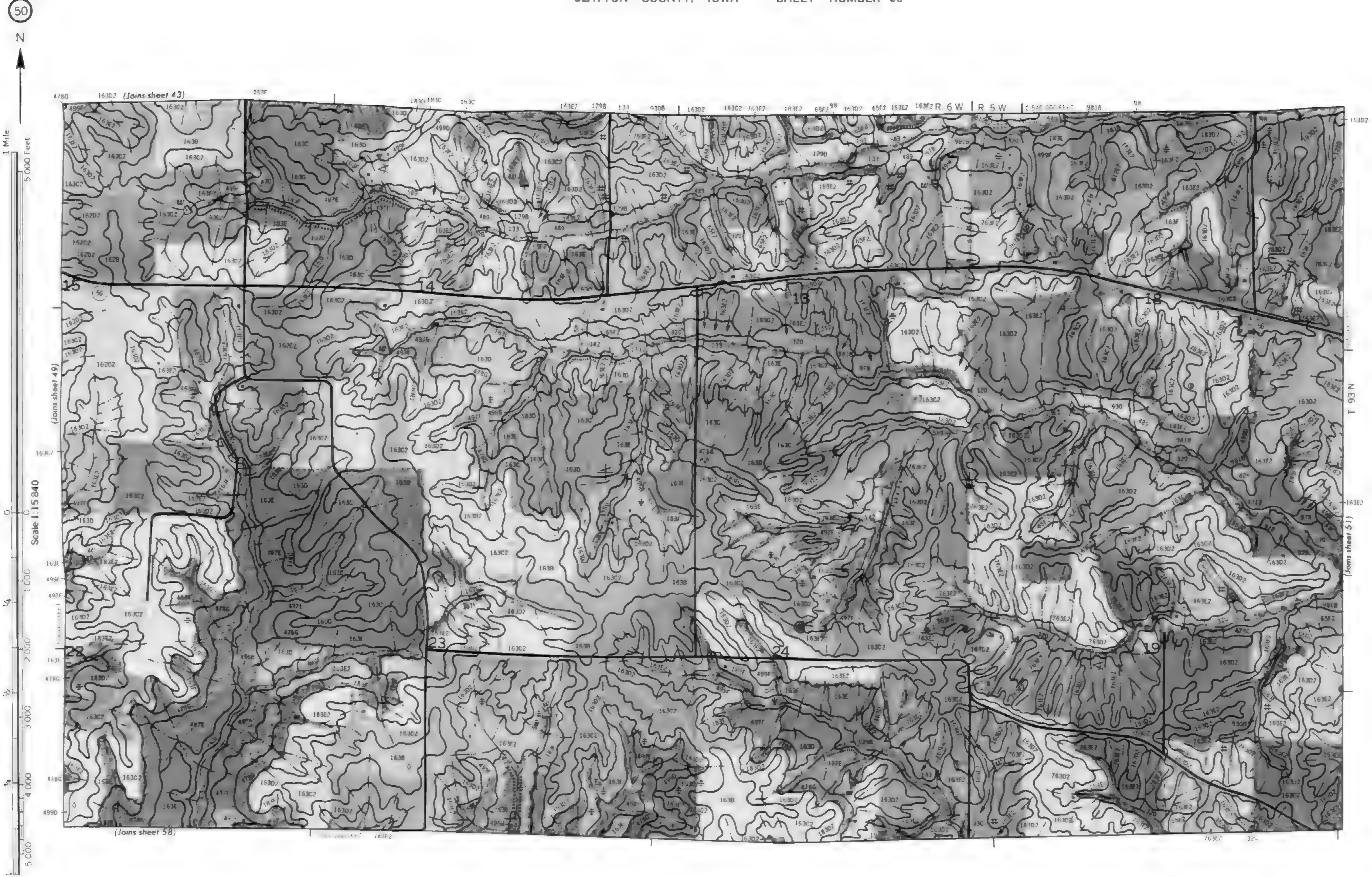

46
N
(Joins sheet 39)
R 4 W
T. 93 N
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 53)
Scale 1:15 840
1 Mile
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾


N
R 4 W | R 3 W
T 93 N
(Joins sheet 40)
(Joins sheet 46)
(Joins sheet 48)
(Joins sheet 54)
Buck Creek
1 Mile
5 000 Feet
Scale 1:15 840
1 000
2 000
3 000
4 000
5 000

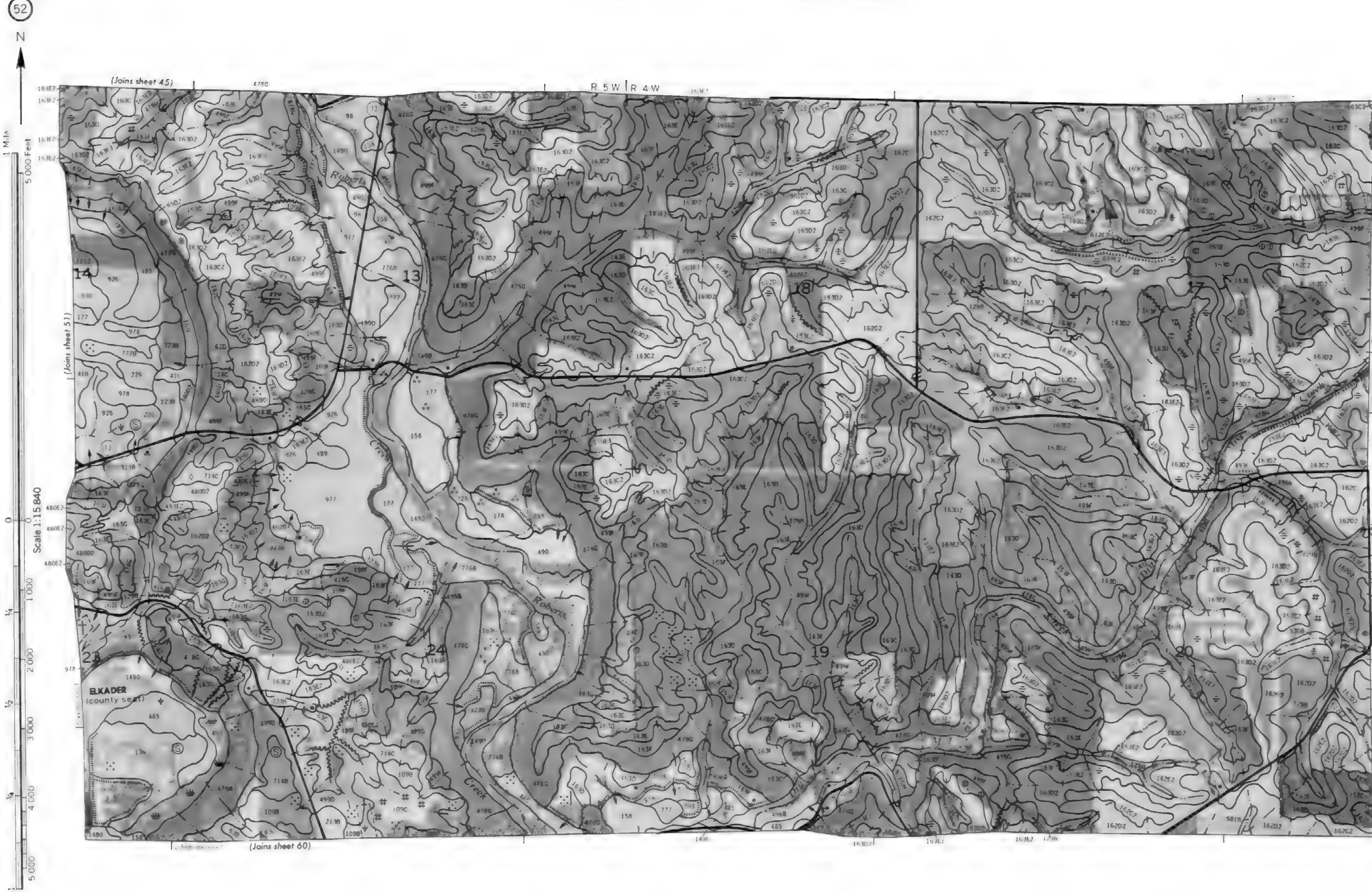

N
(Joins sheet 41)
(Joins sheet 47)
(Joins sheet 55)
(Joins inset, sheet 118)
R 3 W
R 2 W
T 93 N.
Clayton
MISSISSIPPI RIVER
GRANT COUNTY
WISCONSIN
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
1
11
12
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾

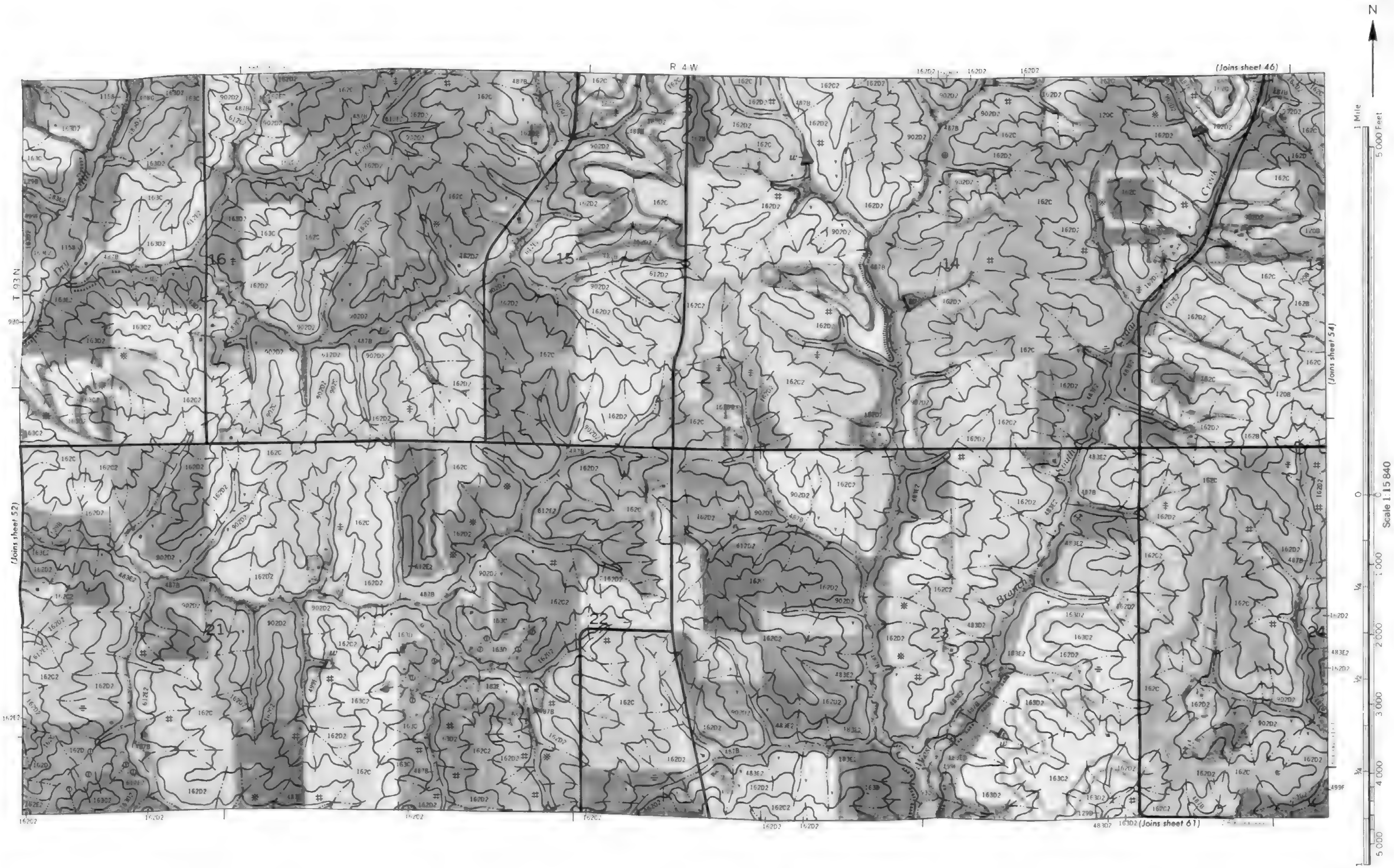

N
R. 6 W.
T 93 N.
FAYETTE COUNTY
(Joins sheet 42)
(Joins sheet 50)
(Joins sheet 57)
17
18
16
19
21
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾

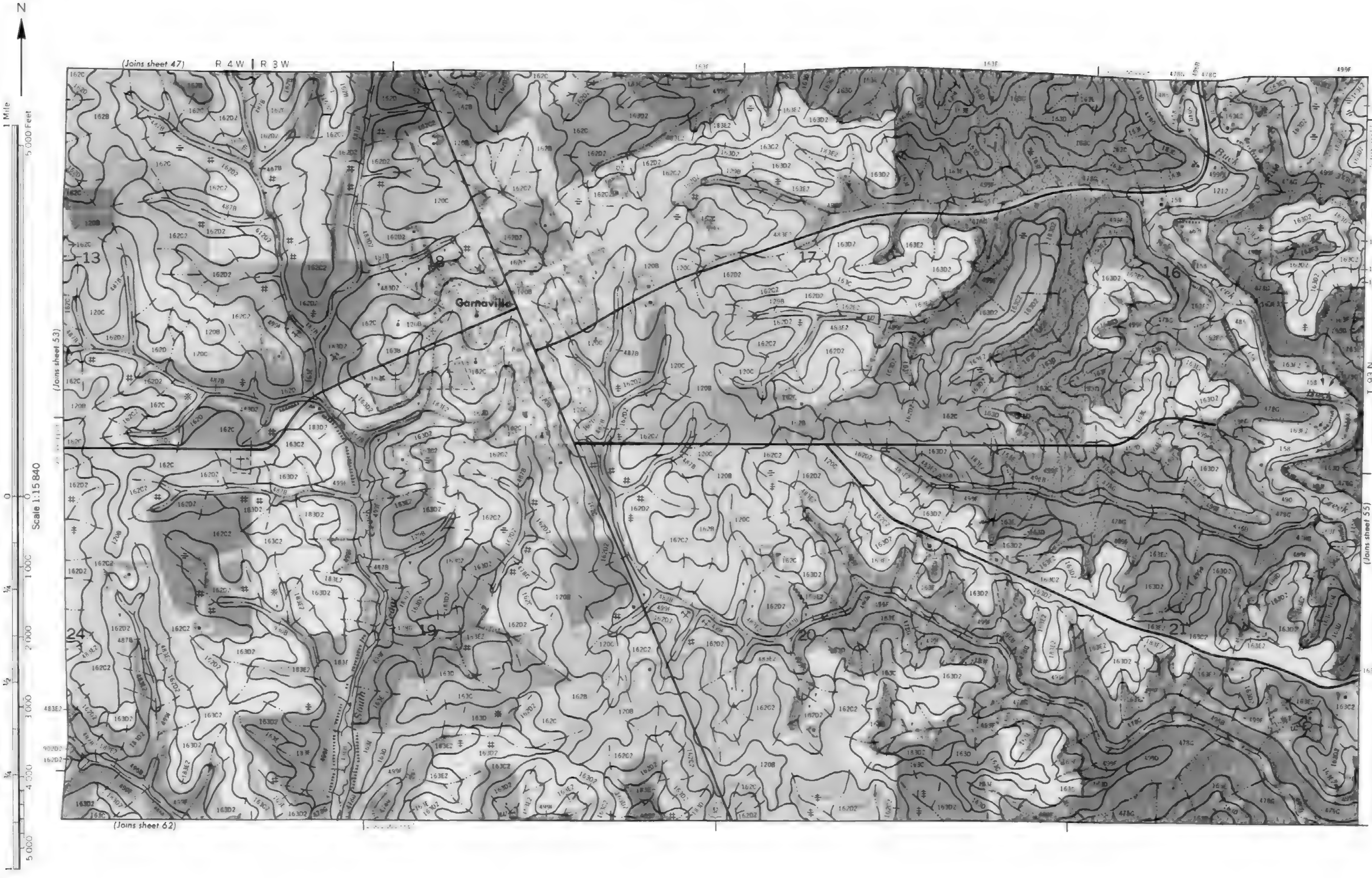
CLAYTON COUNTY, IOWA — SHEET NUMBER 50

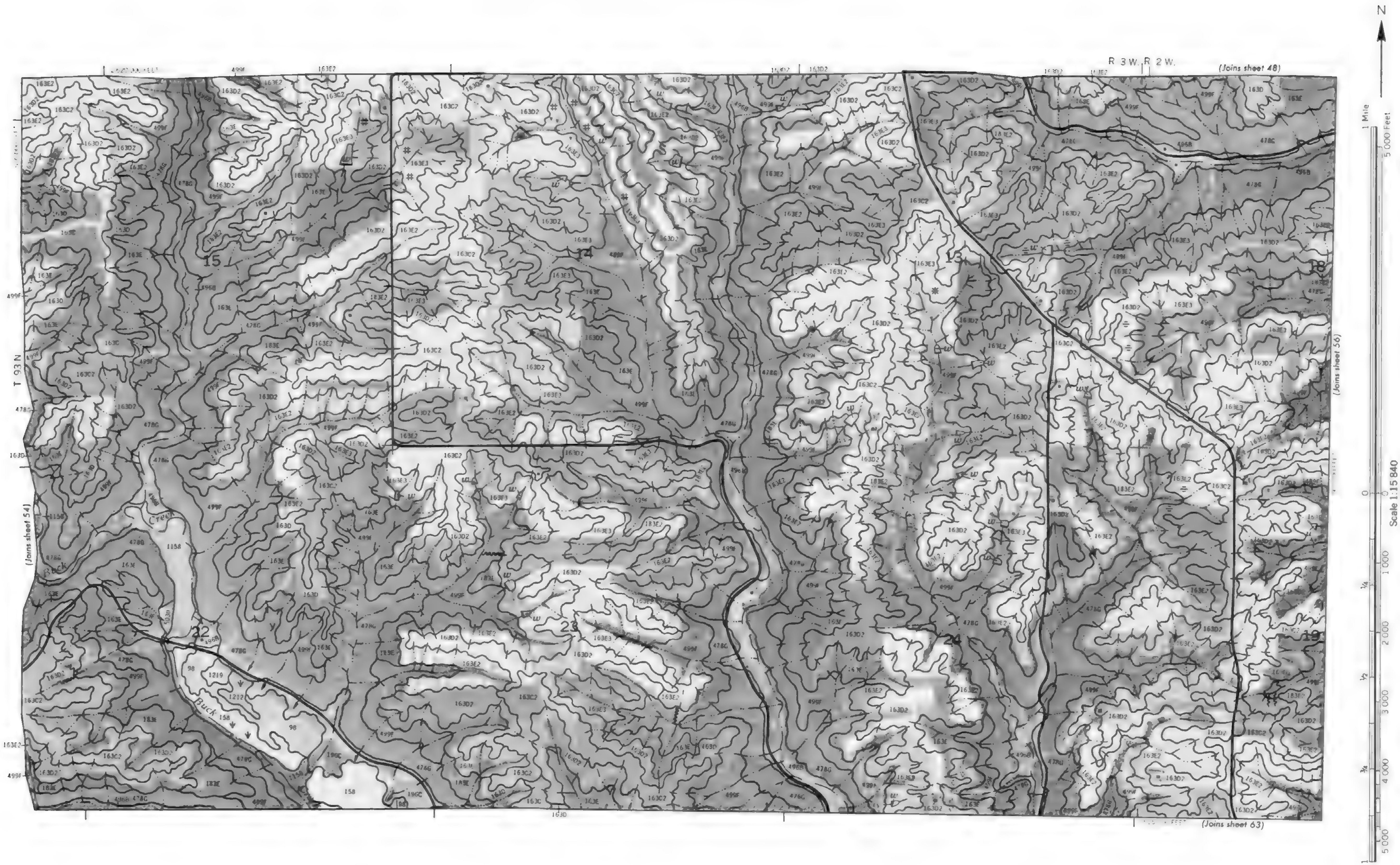


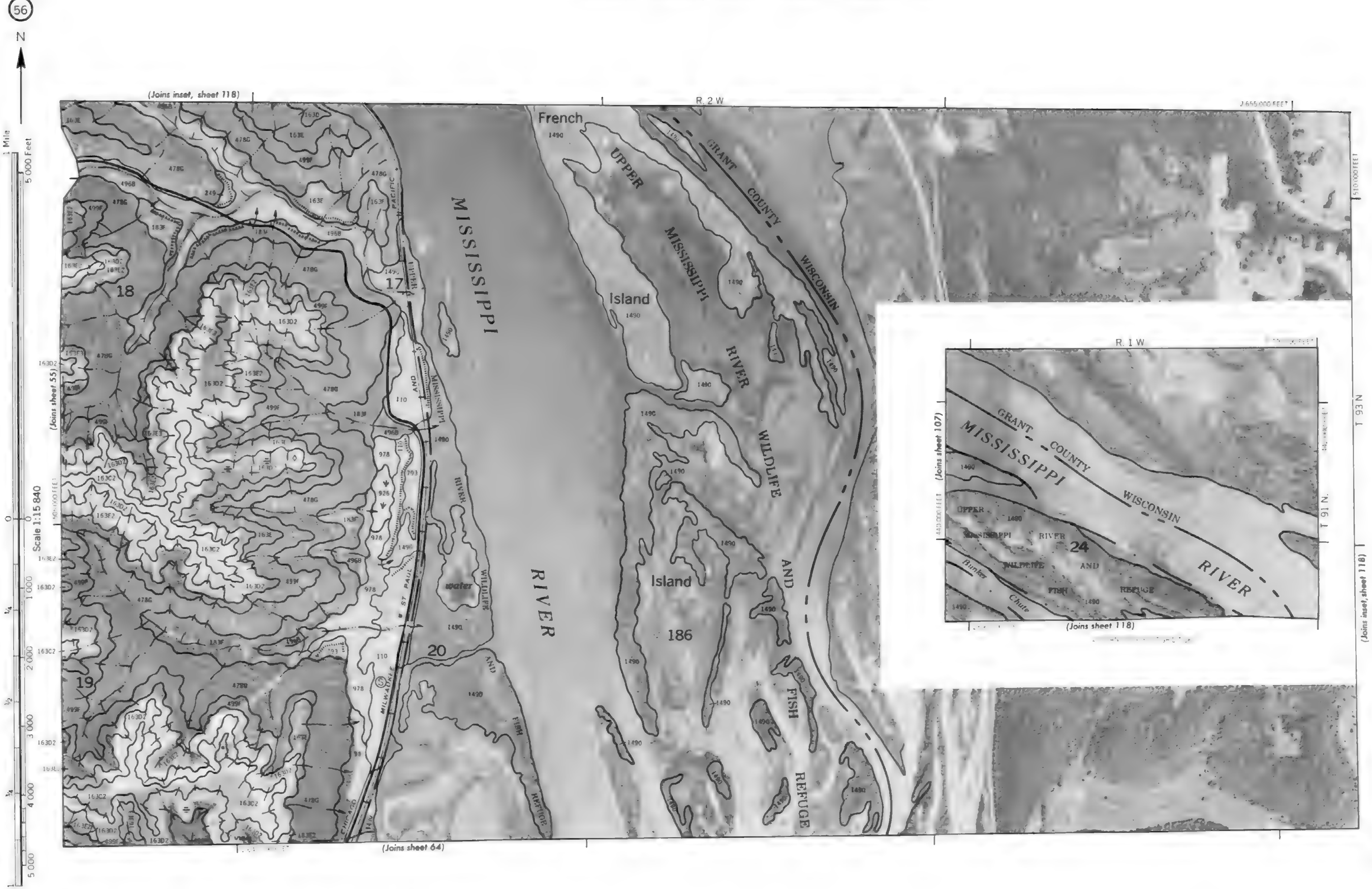

51
N
R 5 W
(Joins sheet 44)
(Joins sheet 52)
(Joins sheet 59)
(Joins sheet 50)
T 93 N
TURKEY
RIVER
ELKADER
(county seat)
17
16
15
14
20
21
22
23
1 Mile
5 000 Feet
Scale 1:15 840


52
N
(Joins sheet 45)
R 5 W | R 4 W
(Joins sheet 51)
(Joins sheet 53)
(Joins sheet 60)
T. 93 N.
Roberts
Creek
13
14
17
18
19
20
23
24
ELKADER
(county seat)
Scale 1:15 840
1 Mile
5 000 Feet

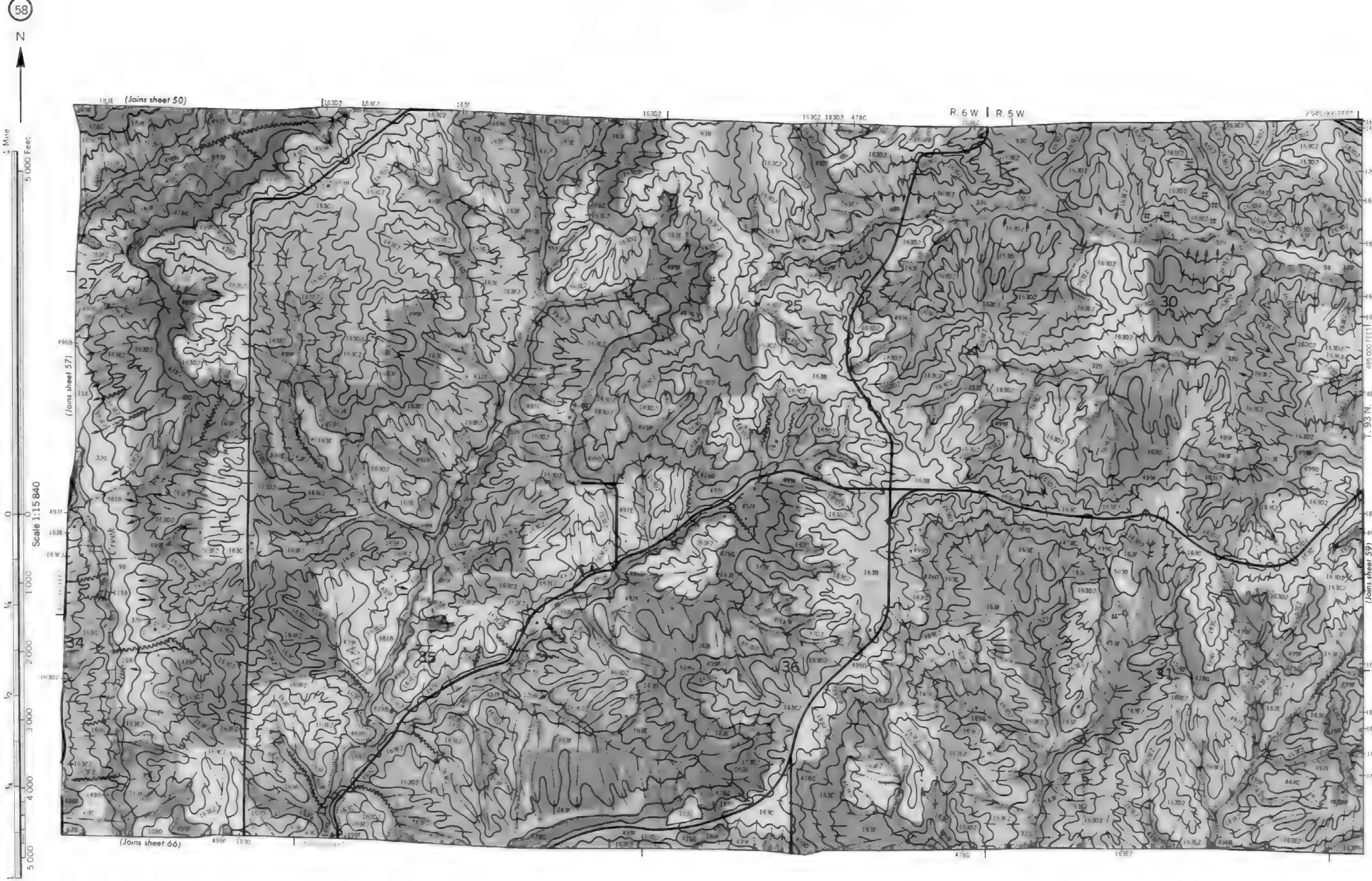

N
R 4 W
T 93 N
(Joins sheet 46)
(Joins sheet 54)
(Joins sheet 52)
(Joins sheet 61)
16
15
14
13
21
22
23
24
Dry
Creek
Branch
1 Mile
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
Scale 1:15 840

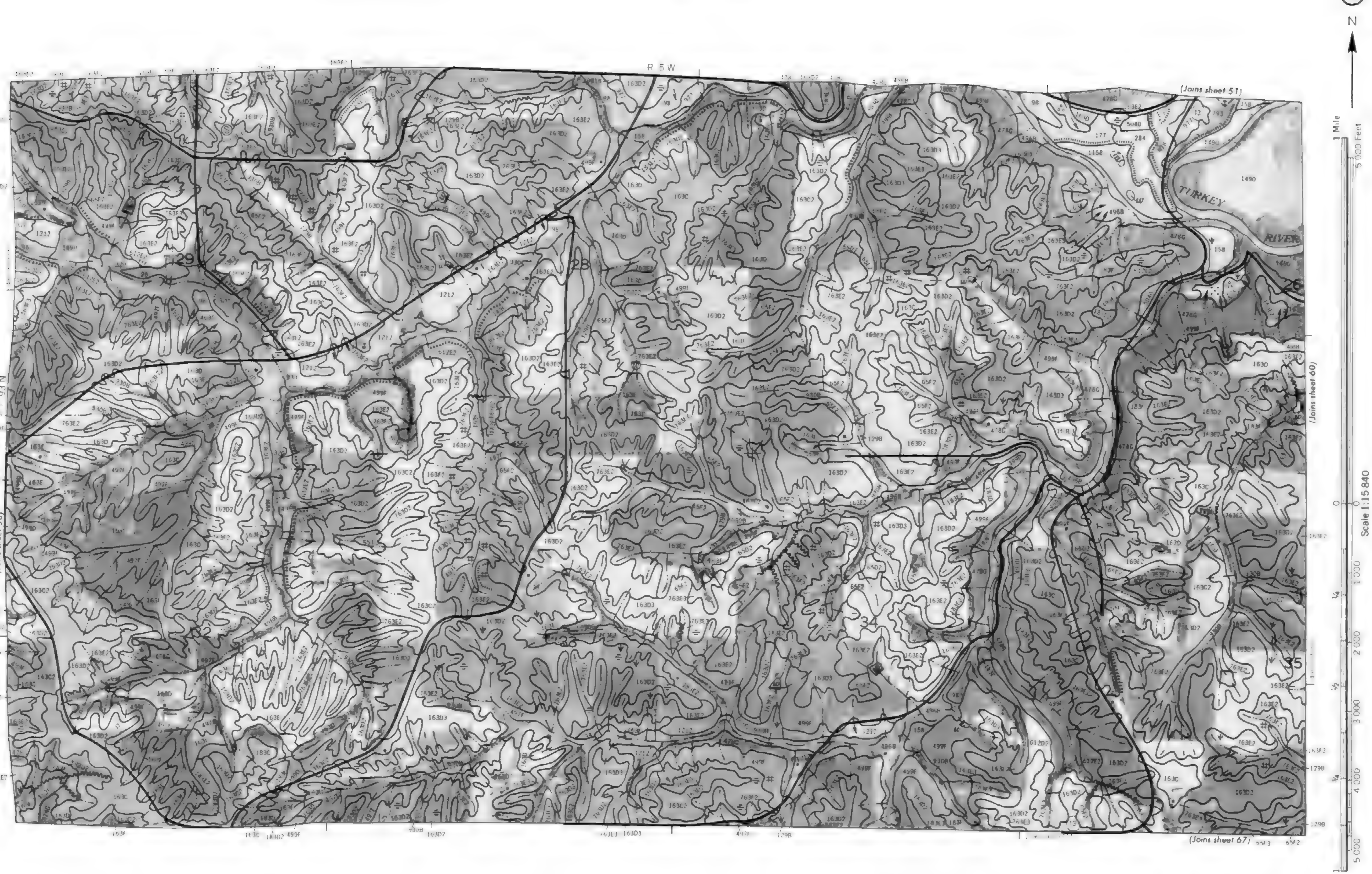

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 47)
R 4 W | R 3 W
(Joins sheet 53)
(Joins sheet 55)
(Joins sheet 62)
T 93 N.
Garnavillo
13
8
17
16
24
19
20
21
Buck
Creek
South


N
R 3 W. R 2 W.
(Joins sheet 48)
(Joins sheet 56)
(Joins sheet 54)
(Joins sheet 63)
T 93 N
Buck Creek
15
14
13
18
22
23
24
19
1 Mile
5 000 Feet
Scale 1:15 840

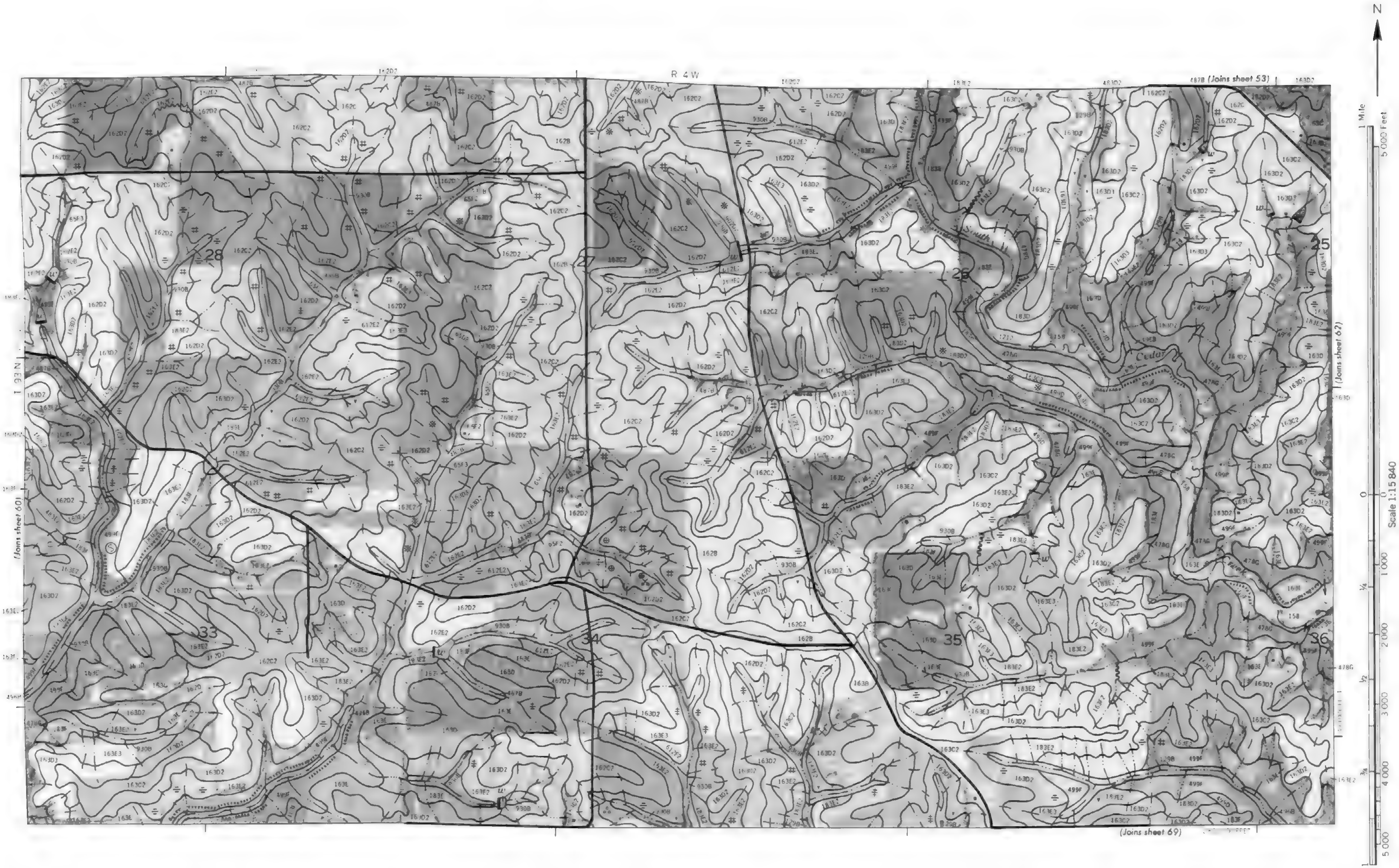

56
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins inset, sheet 118)
R. 2 W
(Joins sheet 55)
(Joins sheet 64)
French
Island
Island
UPPER
MISSISSIPPI
RIVER
WILDLIFE
AND
FISH
REFUGE
MISSISSIPPI
RIVER
GRANT
COUNTY
WISCONSIN
water
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
18
17
19
20
186
R. 1 W
T. 93 N.
T. 91 N.
(Joins sheet 107)
(Joins sheet 118)
(Joins inset, sheet 118)
24
Bunker
Chute


57
N
R 6 W
(Joins sheet 49)
(Joins sheet 58)
(Joins sheet 65)
T 93 N
FAYETTE COUNTY
29
30
28
27
31
32
33
VOLGA
RIVER
Creek
1 Mile
5 000 Feet
Scale 1:15 840

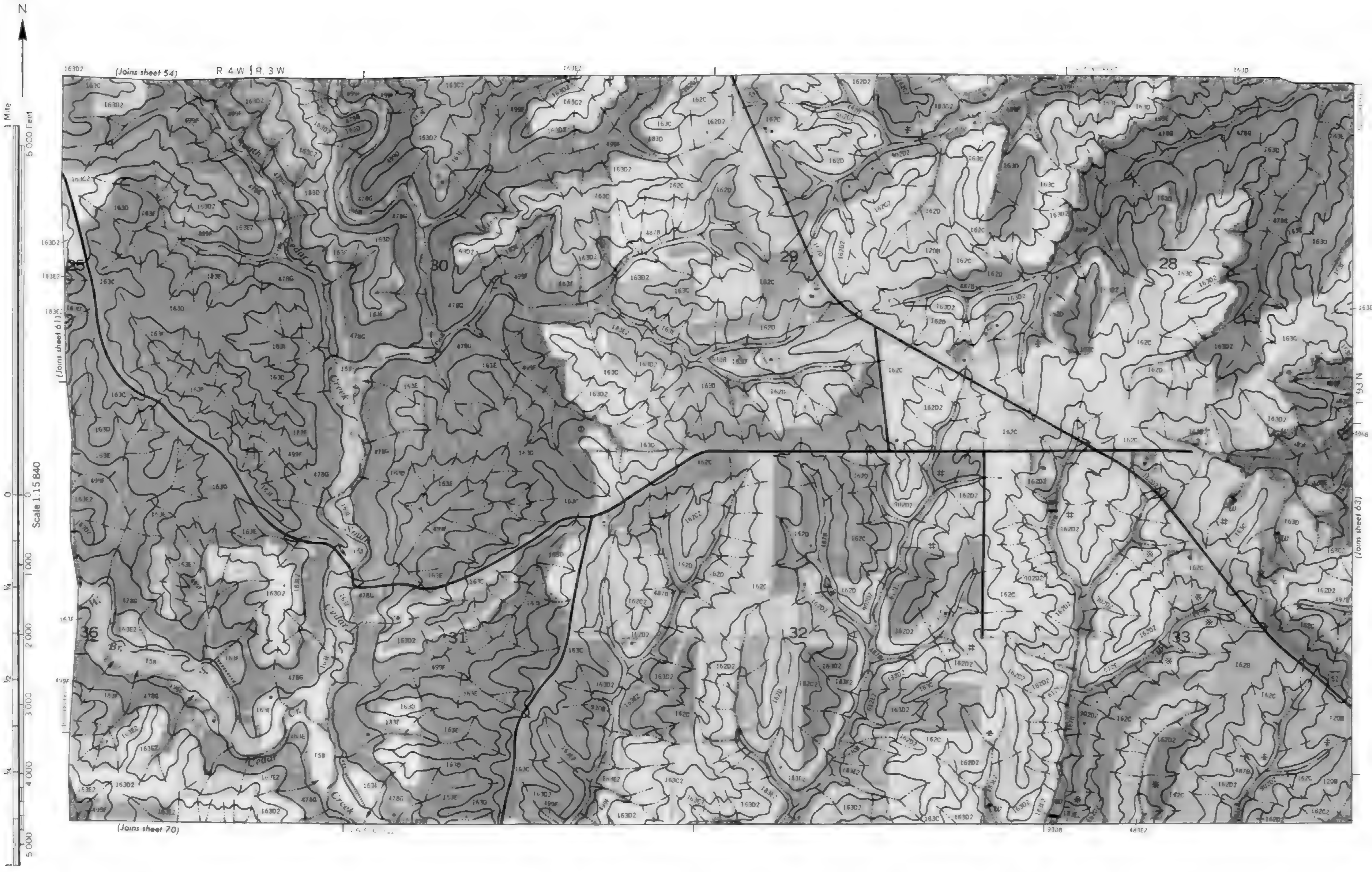

58
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 50)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 66)
R. 6 W
R. 5 W
T. 93 N.
27
26
25
30
34
35
36
31
Creek

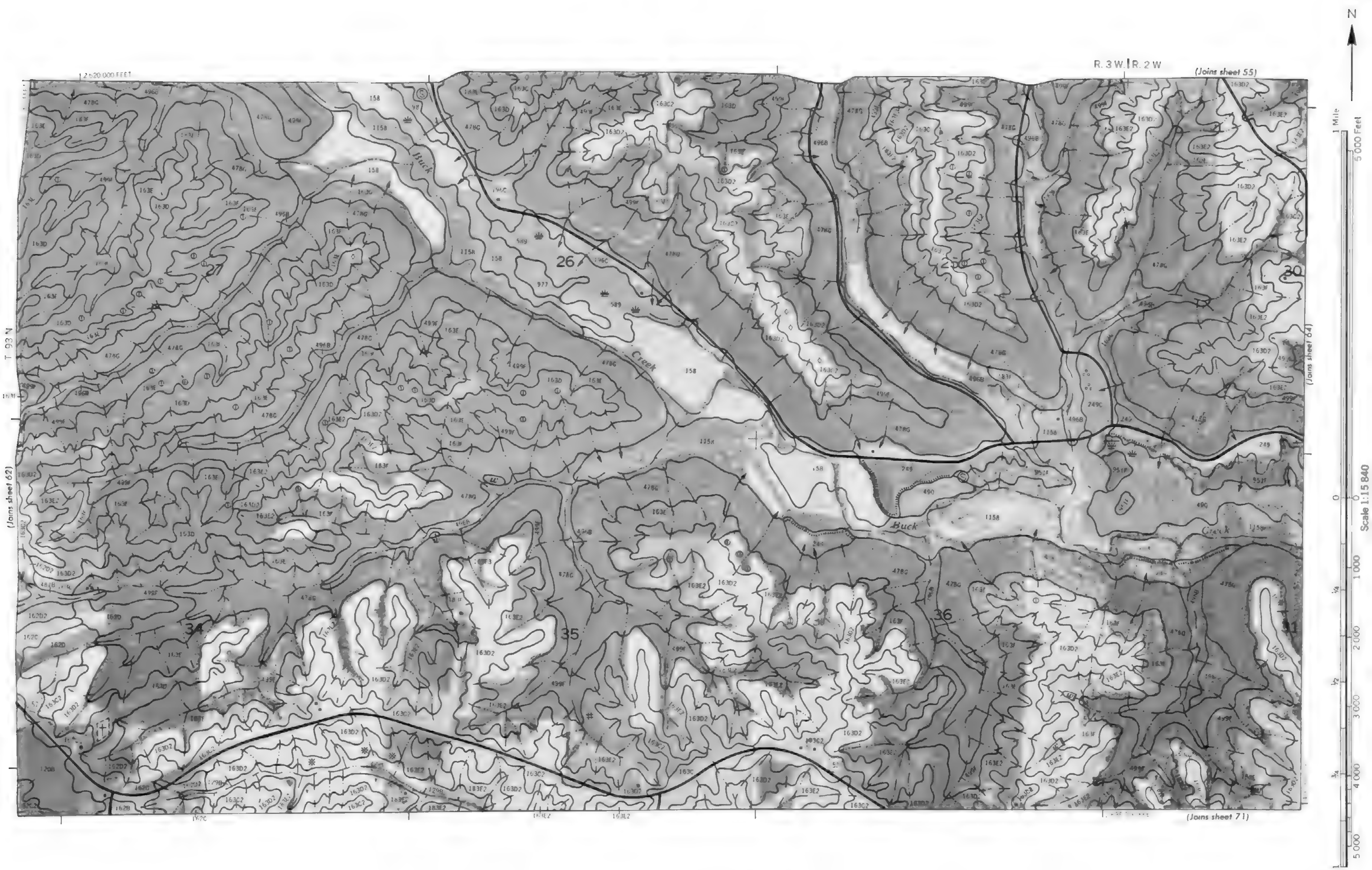

R 5 W
T 93 N
(Joins sheet 51)
(Joins sheet 58)
(Joins sheet 60)
(Joins sheet 67)
TURKEY
RIVER
29
28
26
33
34
35
N
1 Mile
5 000 Feet
Scale 1:15 840

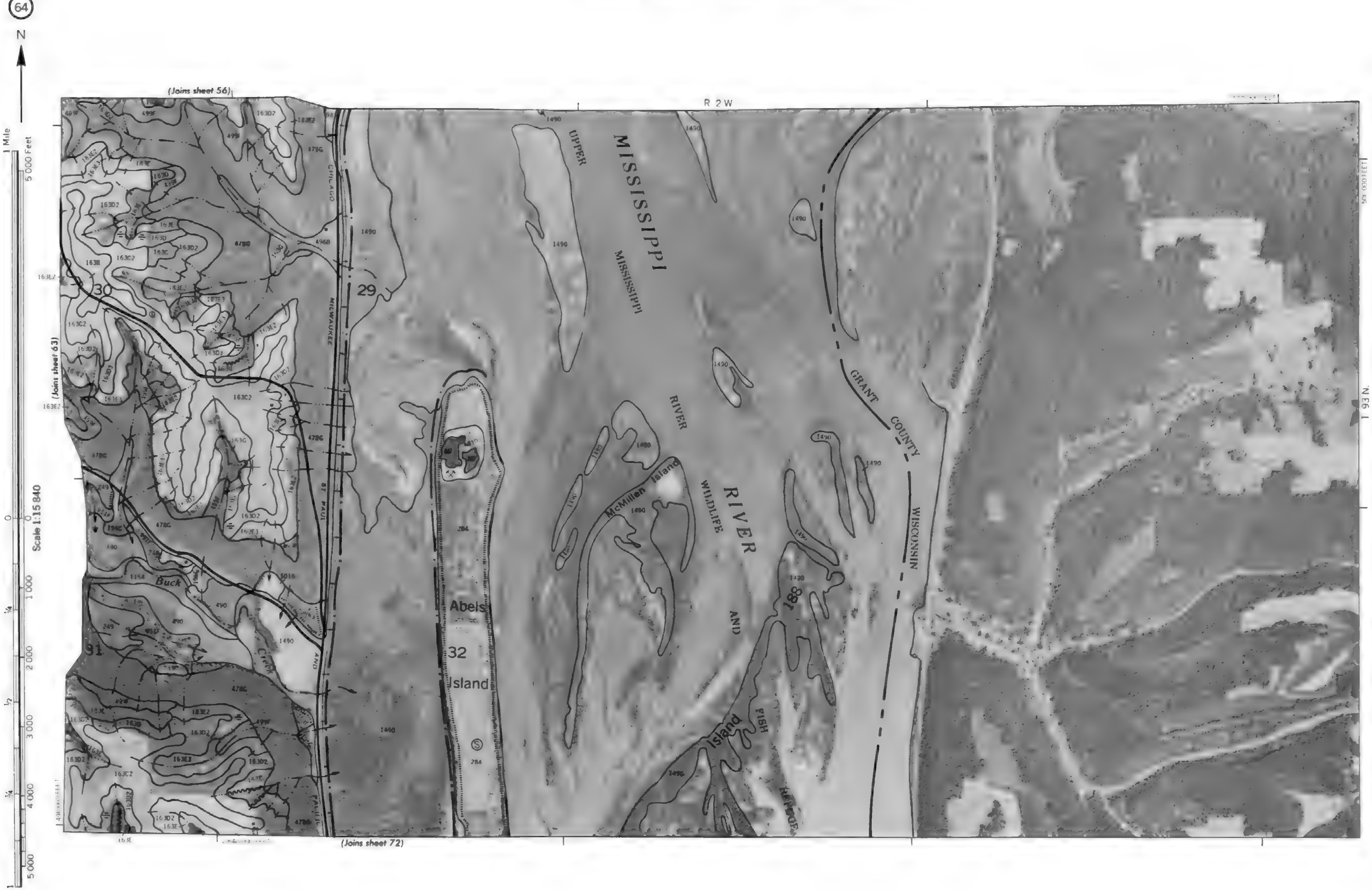

60
N
(Joins sheet 52)
(Joins sheet 59)
(Joins sheet 61)
(Joins sheet 68)
R. 5 W. | R. 4 W.
T. 93 N.
AIRFIELD
TURKEY
RIVER
Creek
Mill
Dry
25
26
29
30
31
32
35
36
Scale 1:15 840
1 Mile
5 000 Feet

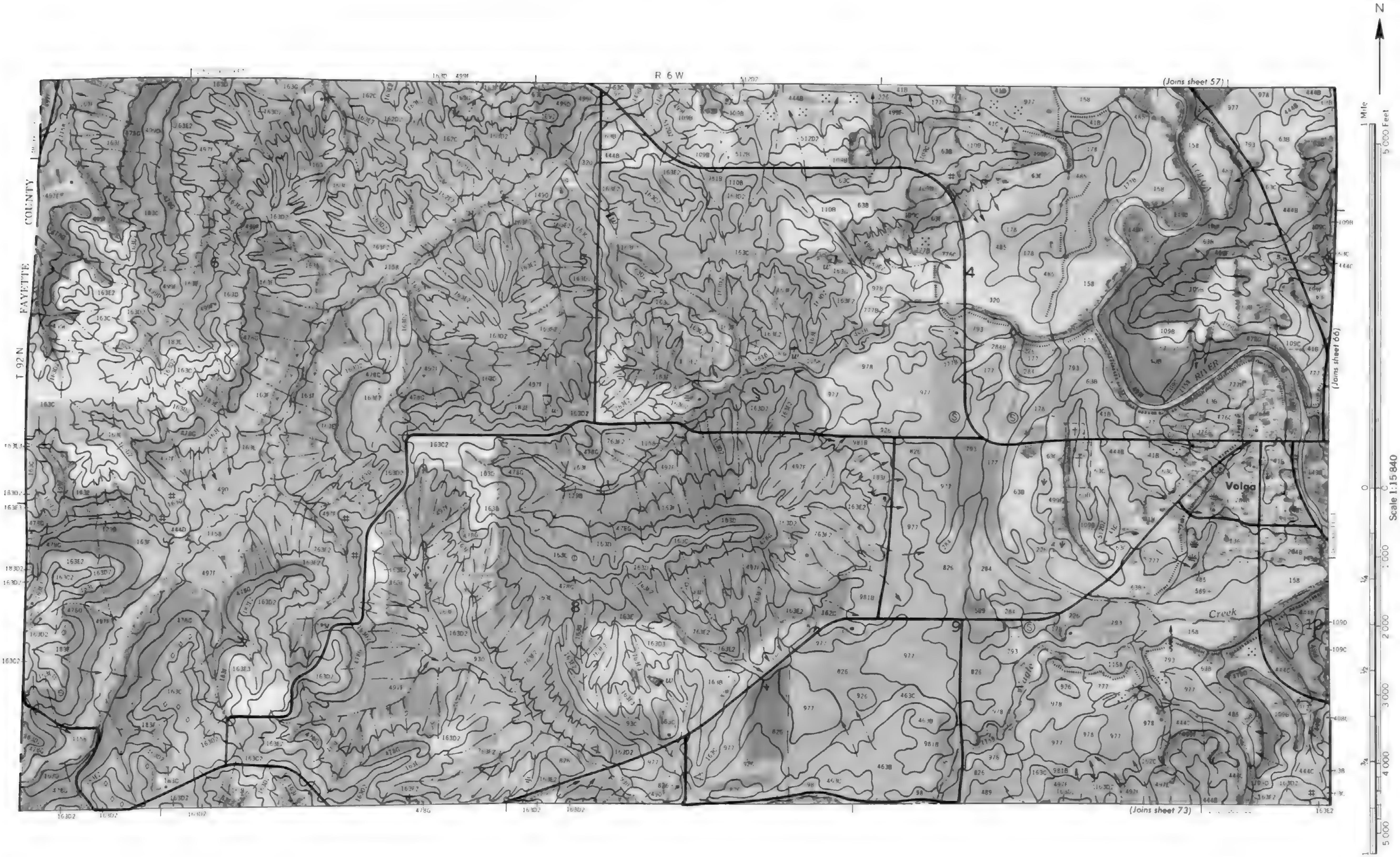

N
R 4 W
T 93 N
(Joins sheet 53)
(Joins sheet 62)
(Joins sheet 69)
(Joins sheet 60)
28
26
25
33
34
35
36
Cedar
1 Mile
5 000 Feet
Scale 1:15 840

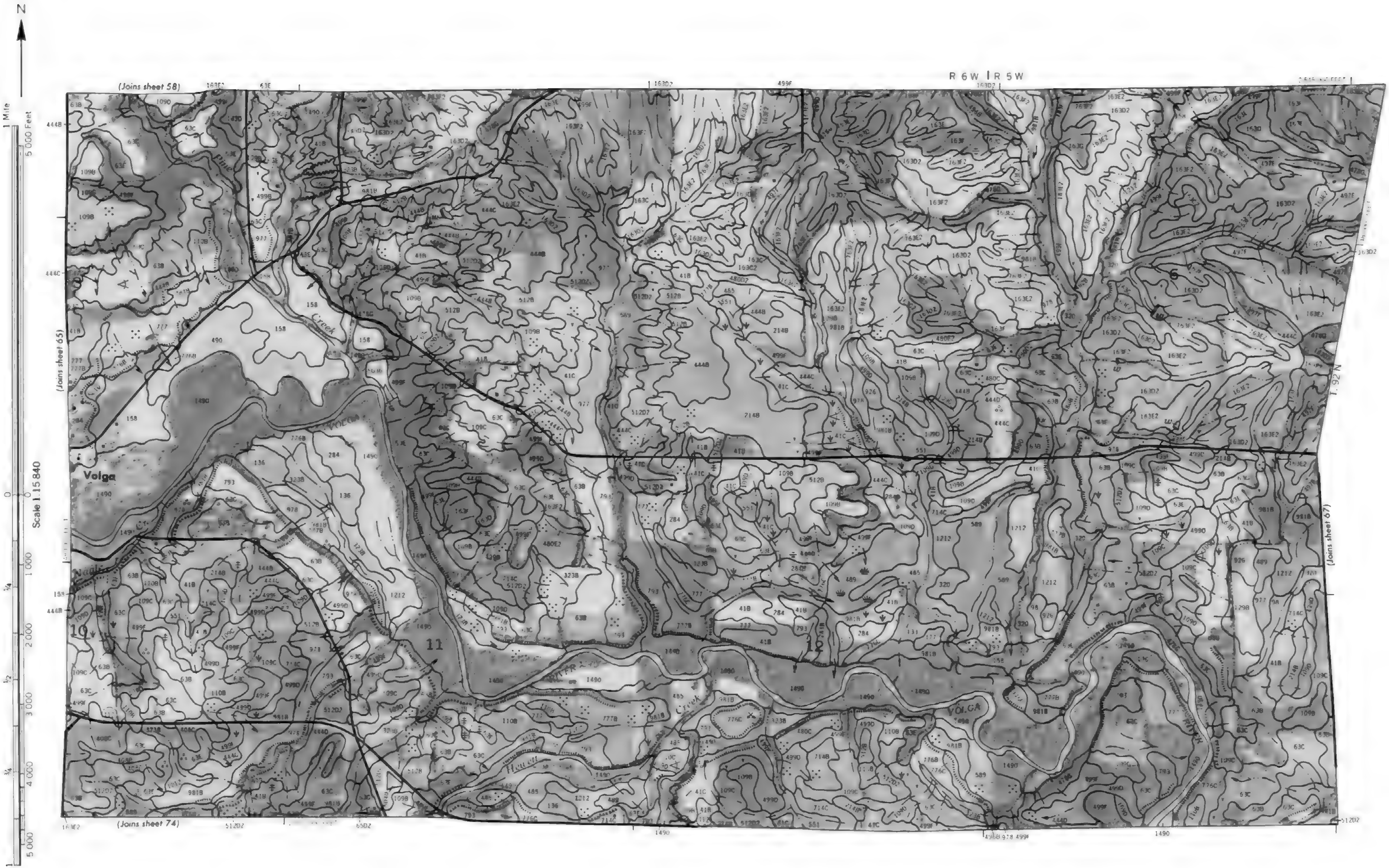
CLAYTON COUNTY, IOWA — SHEET NUMBER 62

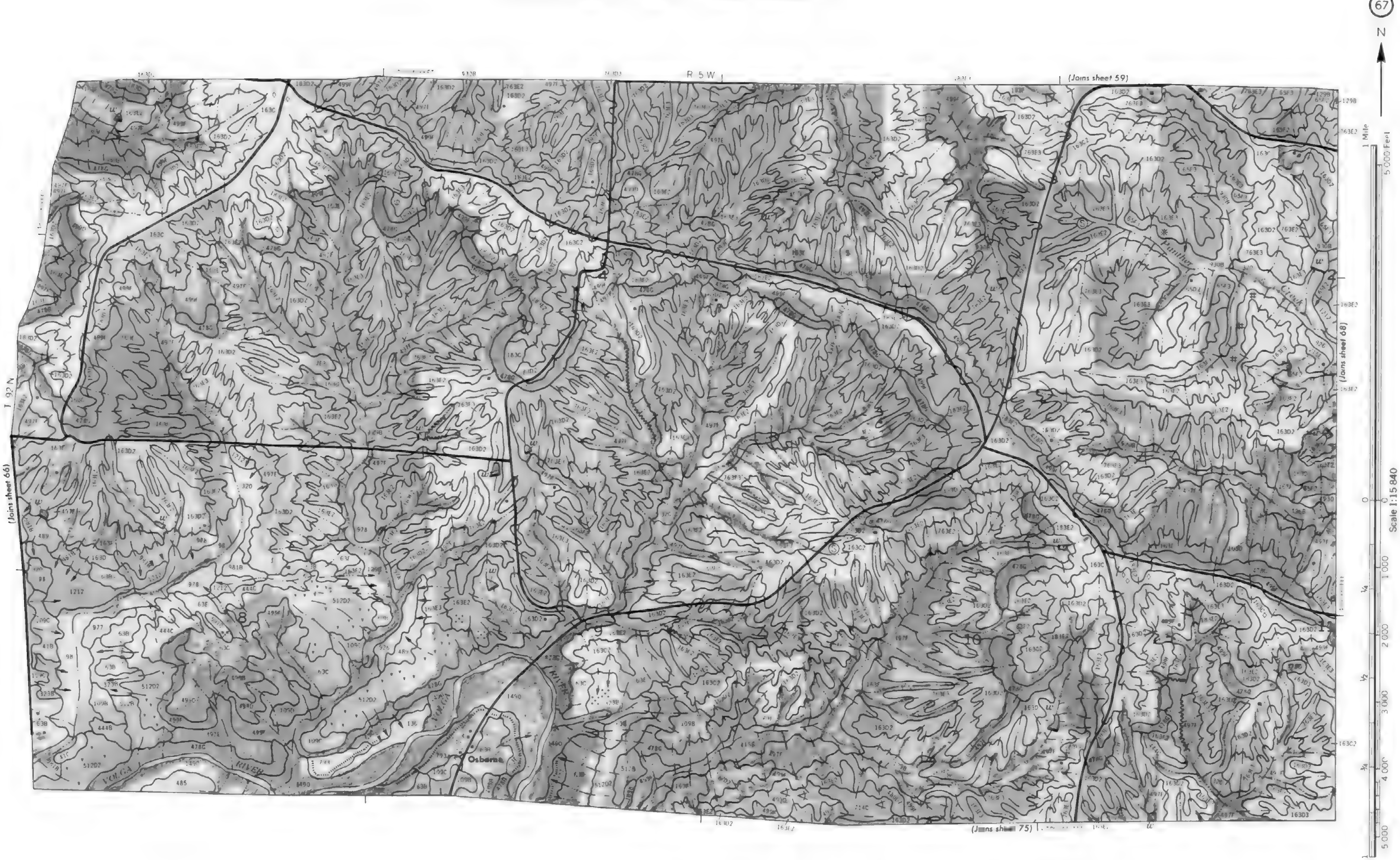



N
R. 3 W. | R. 2 W.
(Joins sheet 55)
(Joins sheet 64)
(Joins sheet 62)
(Joins sheet 71)
T. 93 N.
2 520 000 FEET
Buck
Creek
27
26
25
30
34
35
36
31
1 Mile
5 000 Feet
Scale 1:15 840

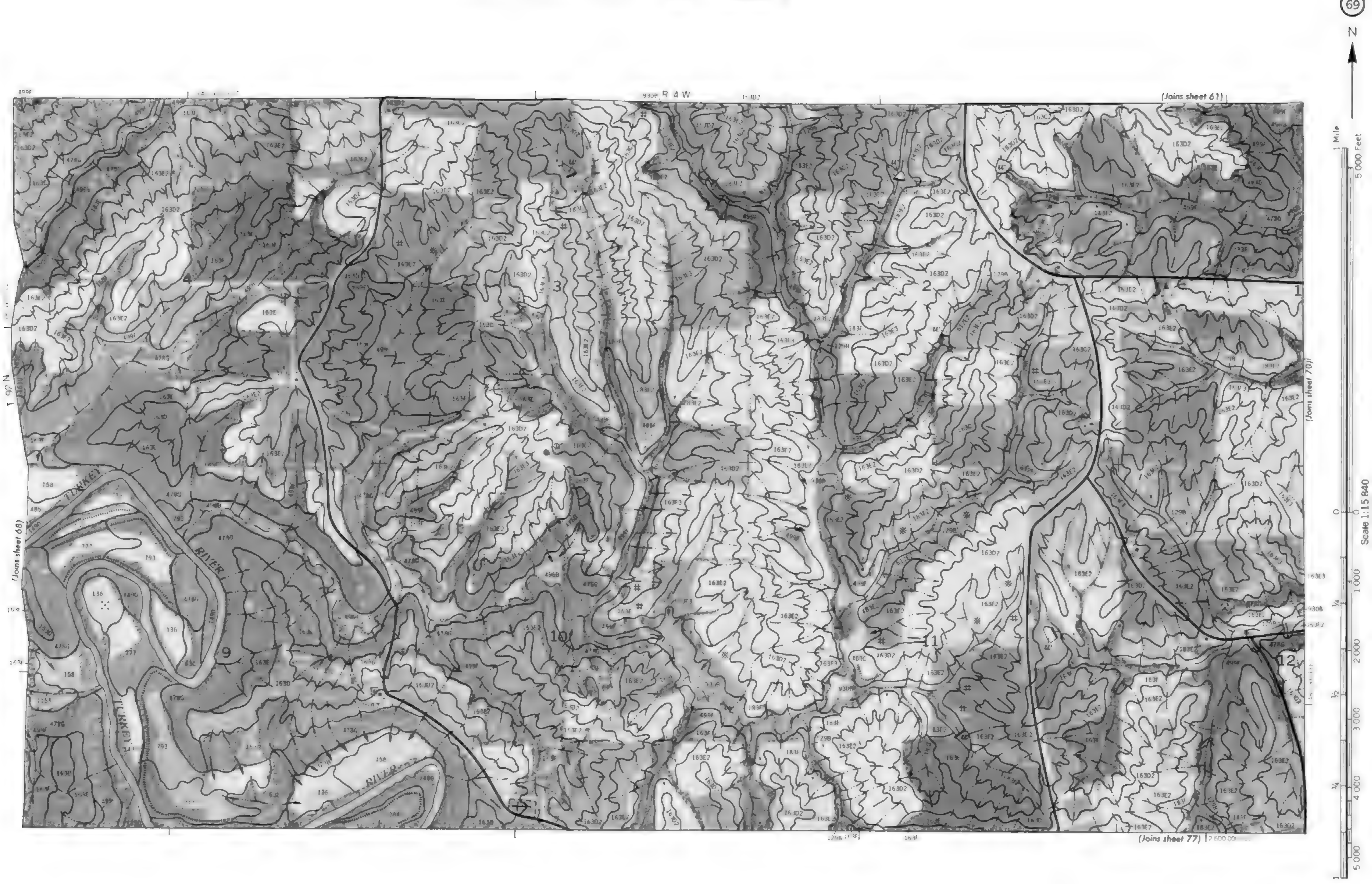

64
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 56)
(Joins sheet 63)
(Joins sheet 72)
R 2 W
T 93 N.
UPPER MISSISSIPPI RIVER
MISSISSIPPI RIVER
MISSISSIPPI
McMillen Island
WILDLIFE AND FISH REFUGE
Island
GRANT COUNTY
WISCONSIN
Abels Island
CHICAGO MILWAUKEE ST PAUL AND PACIFIC
Buck Creek
29
30
31
32
188

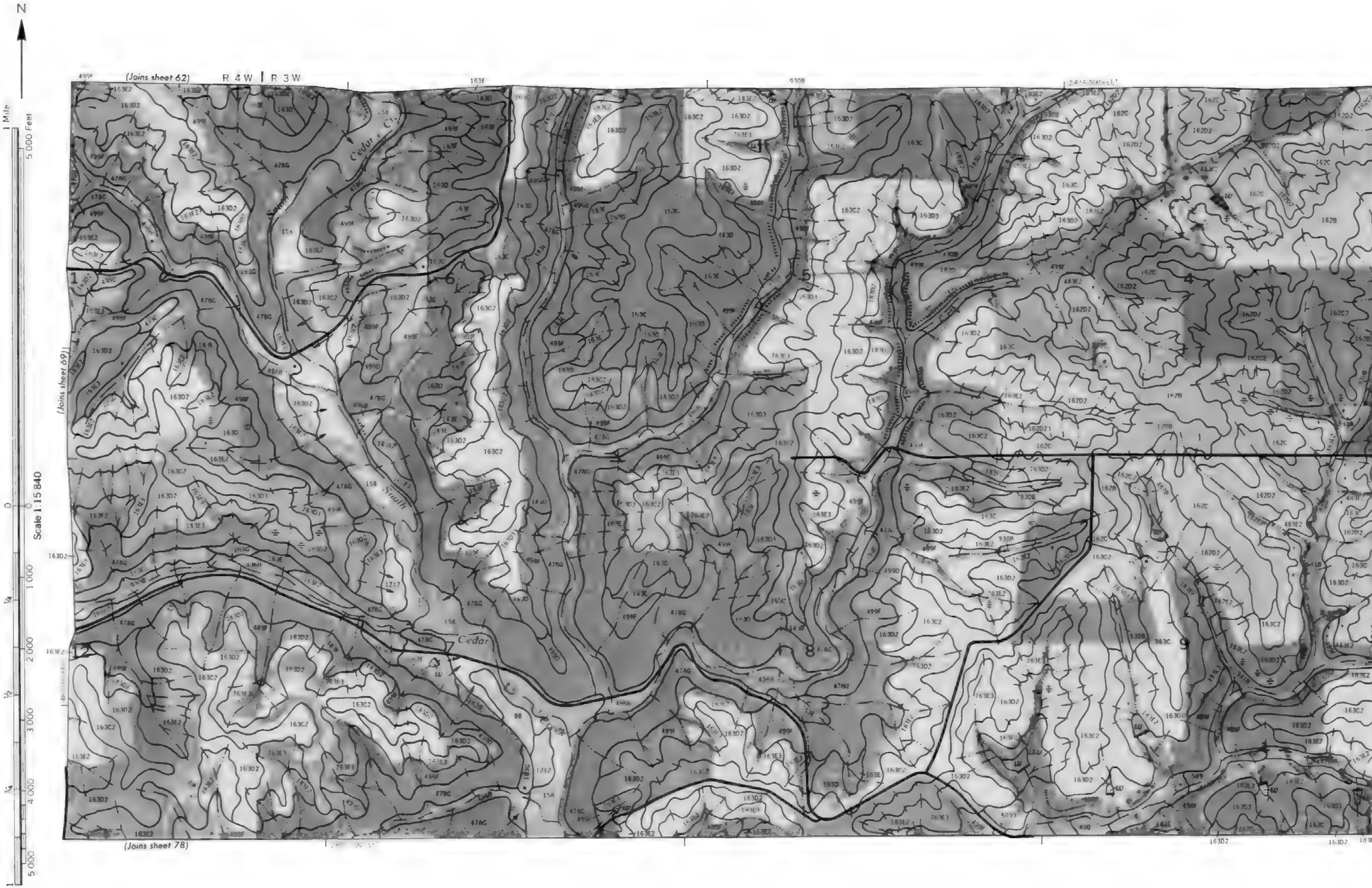

N
R 6 W
(Joins sheet 57)
FAYETTE COUNTY
T 92 N
(Joins sheet 66)
Volga
RIVER
Creek
(Joins sheet 73)
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 58)
(Joins sheet 65)
(Joins sheet 67)
(Joins sheet 74)
R 6 W | R 5 W
T. 92 N
Volga
Volga
Creek
10
11
6


67
N
R 5 W
(Joins sheet 59)
(Joins sheet 68)
(Joins sheet 66)
T 92 N
Osborne
VOLGA
RIVER
1 Mile
5 000 Feet
Scale 1:15 840

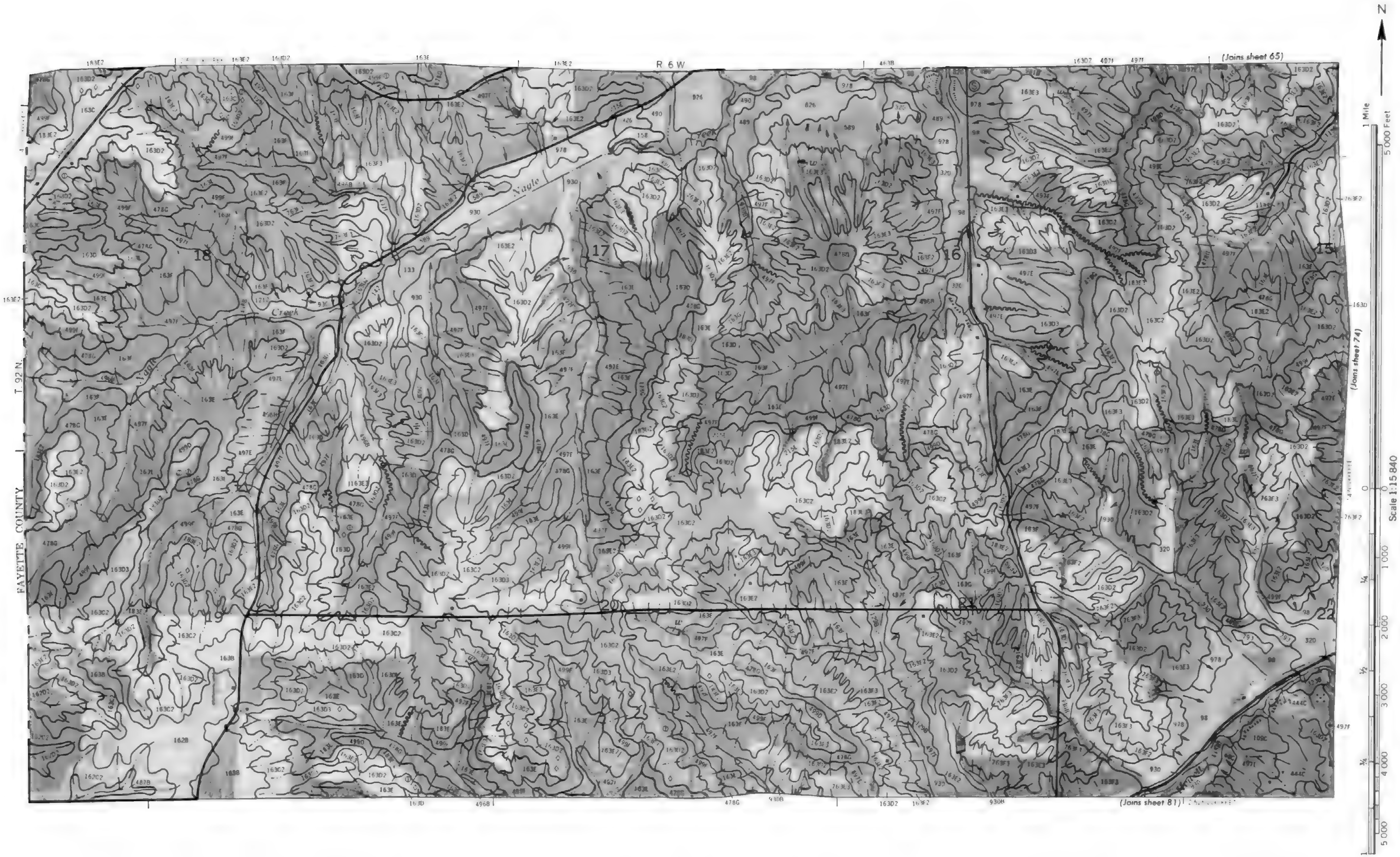

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 60)
R 5 W | R. 4 W
(Joins sheet 67)
(Joins sheet 69)
(Joins sheet 76)
T 92 N.
TURKEY RIVER
Panther Creek


69
N
R 4 W
(Joins sheet 61)
(Joins sheet 70)
(Joins sheet 68)
(Joins sheet 77)
T 92 N
TURKEY
RIVER
TURKEY
RIVER
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 62)
R 4 W
R 3 W
(Joins sheet 69)
(Joins sheet 71)
(Joins sheet 78)
T 92 N
Cedar Cr.
South
Cedar
Creek


71
N
R. 3 W. | R. 2 W.
(Joins sheet 63)
(Joins sheet 72)
(Joins sheet 79)
(Joins sheet 70)
T. 92 N.
Creek
Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
3
10
11
12

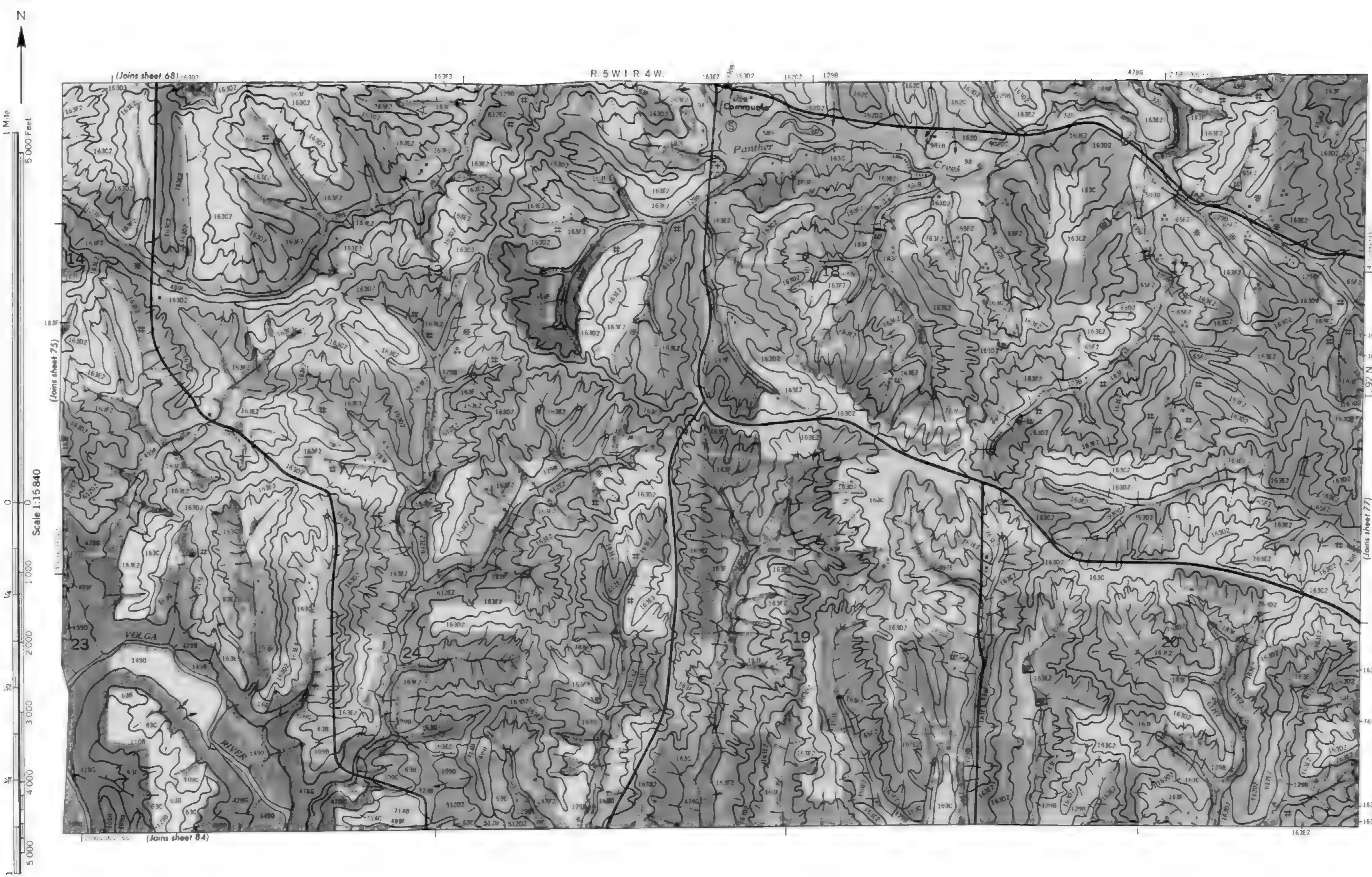

72
N
(Joins sheet 64)
R 2 W
(Joins sheet 71)
(Joins sheet 80)
T. 92 N.
Scale 1:15 840
1 Mile
5 000 Feet
UPPER
MISSISSIPPI
RIVER
WILDLIFE
AND
FISH
REFUGE
MISSISSIPPI
RIVER
Island
Island 189
188
Slough
Ferry
GUTTENBERG
GUTTENBERG MUNICIPAL AIRPORT
GRANT COUNTY WISCONSIN
CHICAGO MILWAUKEE ST PAUL AND PACIFIC
5040



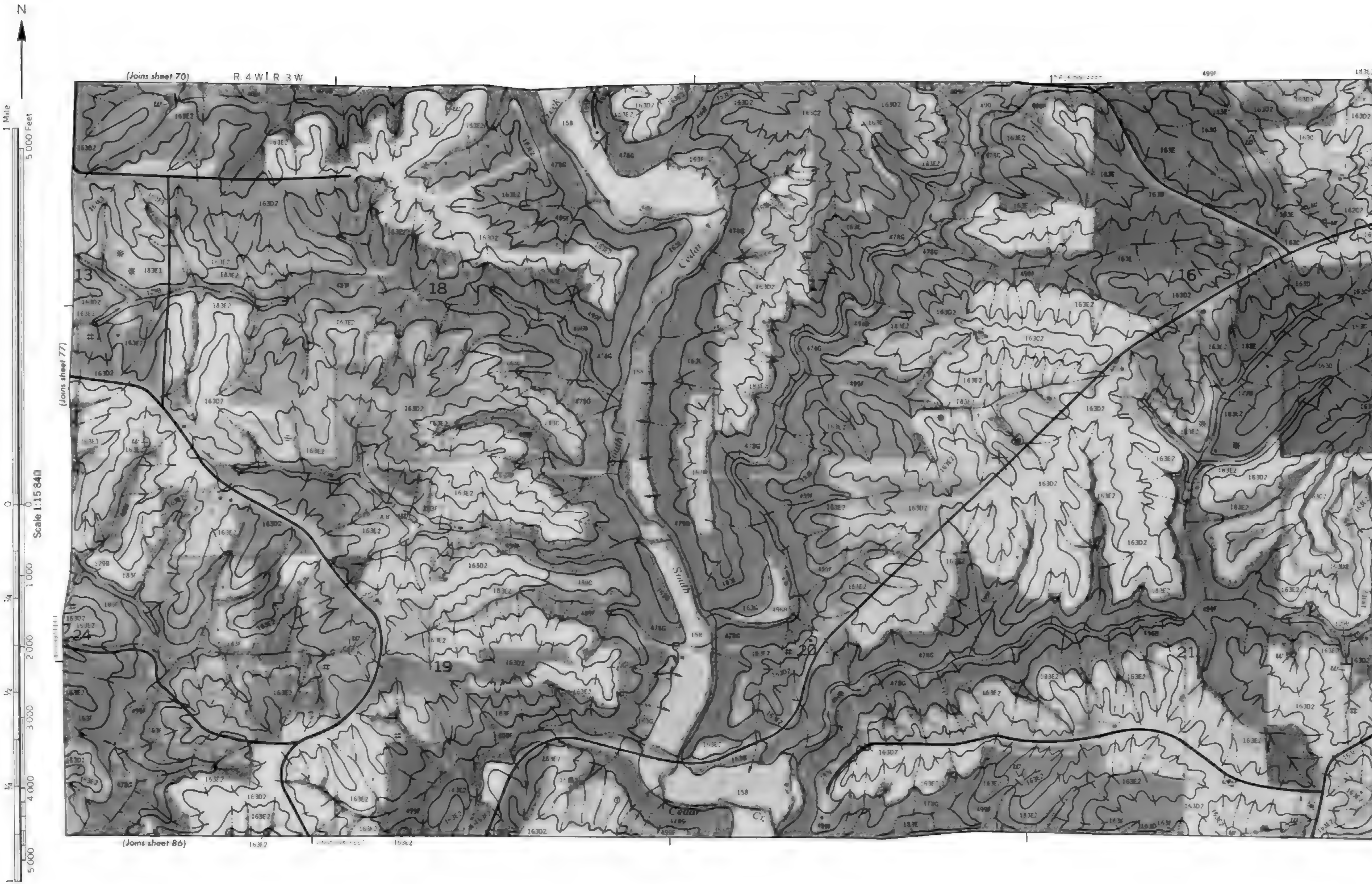
N
R 6 W
(Joins sheet 65)
(Joins sheet 74)
(Joins sheet 81)
T. 92 N.
FAYETTE COUNTY
Nagle
Creek
18
17
16
15
19
20
21
22
1 Mile
5 000 Feet
Scale 1:15 840

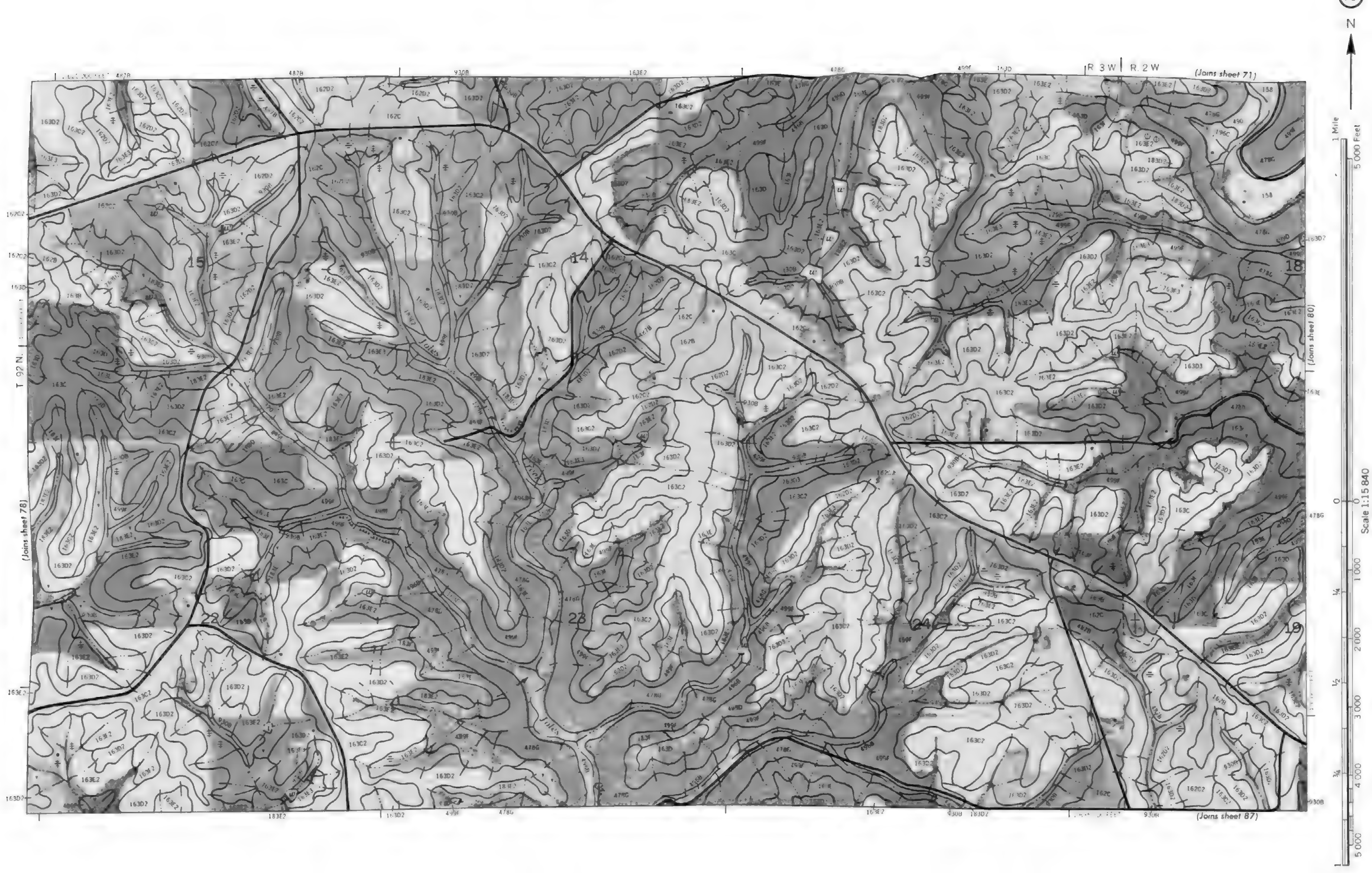
CLAYTON COUNTY, IOWA — SHEET NUMBER 74


N
(Joins sheet 67)
R 5 W.
T 92 N
(Joins sheet 76)
(Joins sheet 74)
(Joins sheet 83)
VOLGA
RIVER
Cox Creek
Mederville
1
16
15
20
21
22
23
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾

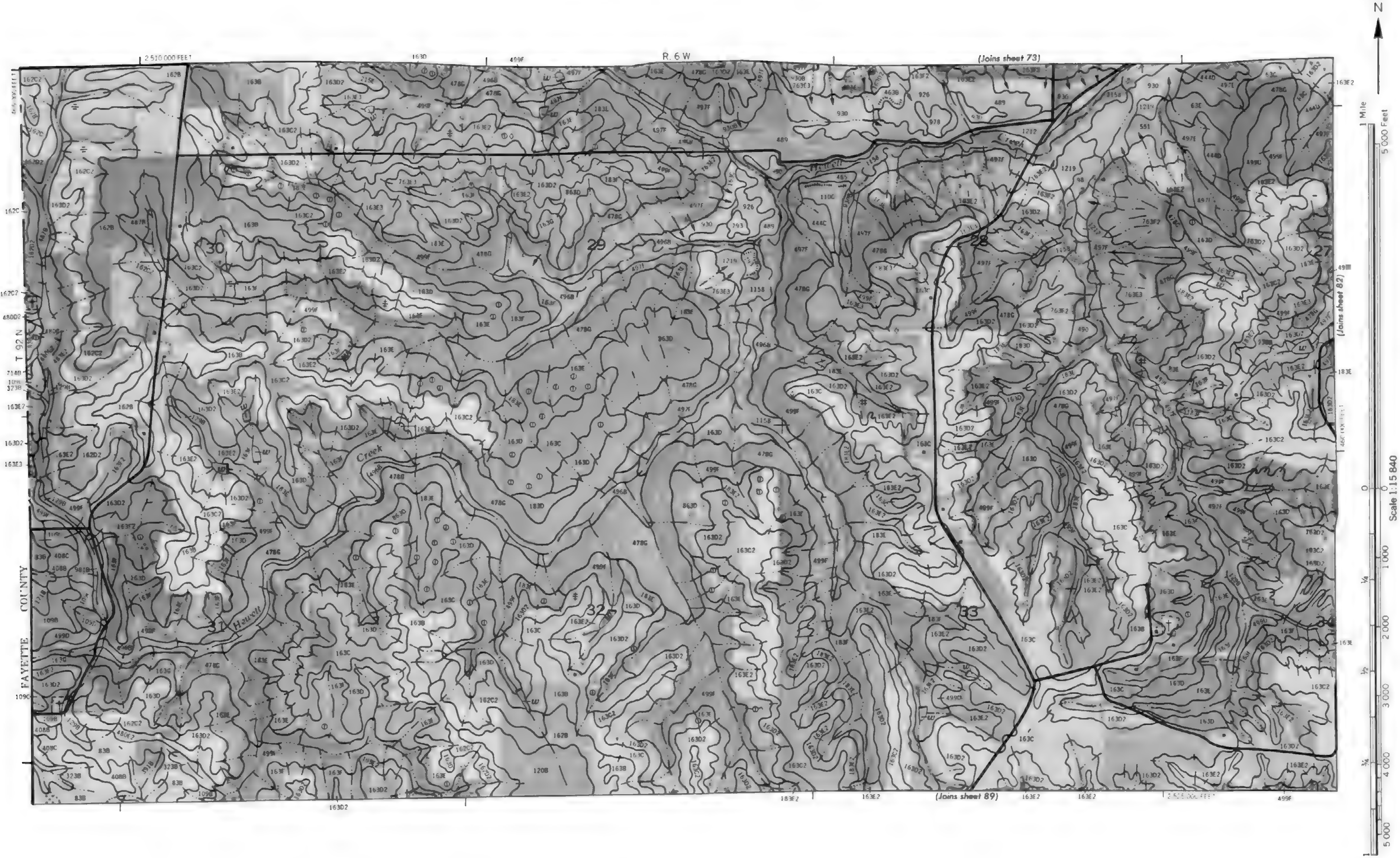

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 68)
R. 5 W. | R. 4 W.
(Joins sheet 75)
(Joins sheet 77)
(Joins sheet 84)
T. 92 N.
Communia
Panther
Creek
VOLGA
RIVER
14
18
17
23
24
19
20


R 4 W
T 92 N
(Joins sheet 69)
(Joins sheet 78)
(Joins sheet 85)
(Joins sheet 76)
16
15
14
13
21
22
23
24
TURKEY
RIVER
RIVER
RIVER
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾

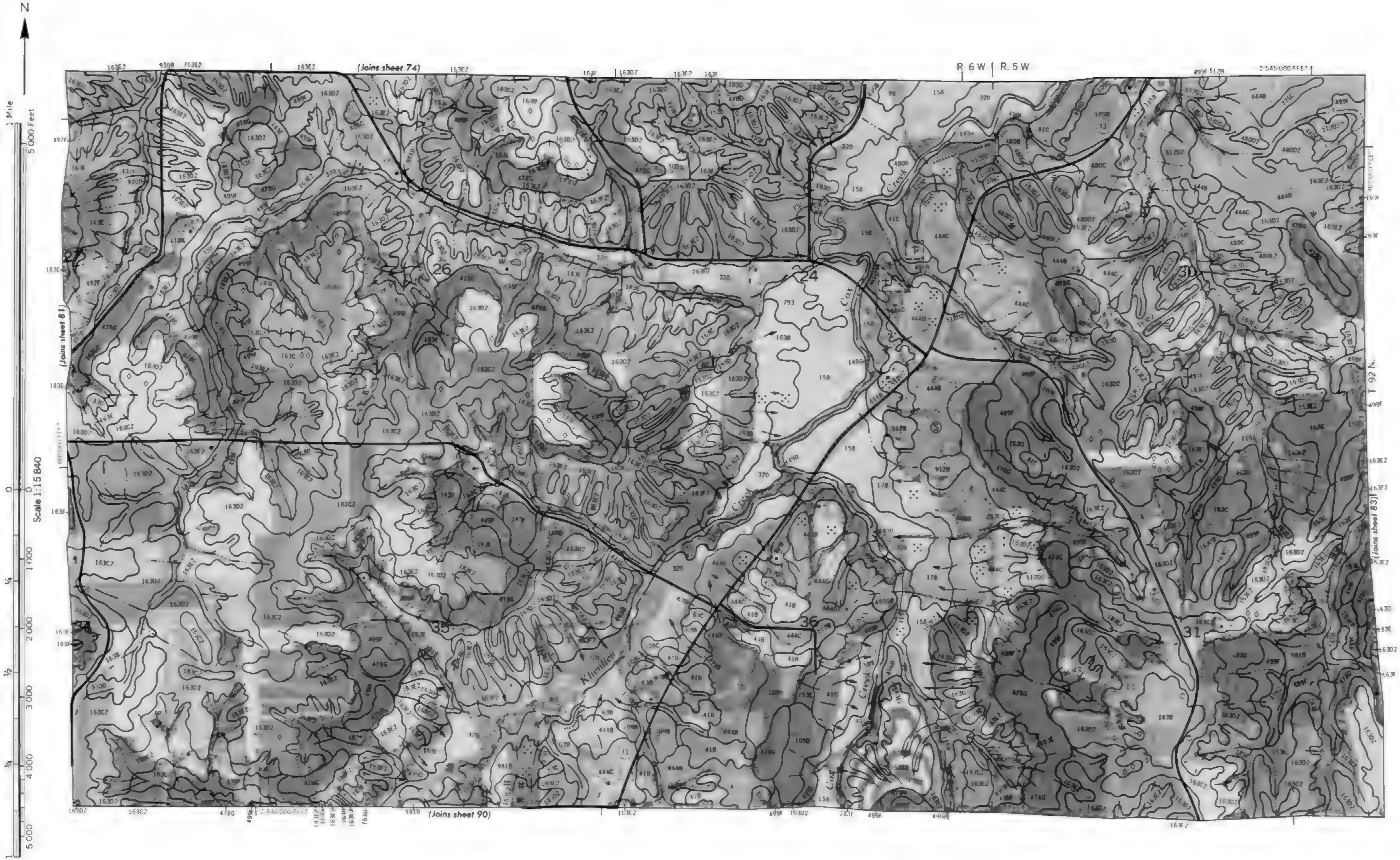

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 70)
R. 4 W. | R. 3 W.
(Joins sheet 77)
(Joins sheet 79)
(Joins sheet 86)
T. 92 N.
13
18
17
16
24
19
20
21
South
Cedar
Cr.


79
N
R 3 W
R. 2 W
(Joins sheet 71)
(Joins sheet 78)
(Joins sheet 80)
(Joins sheet 87)
T. 92 N.
13
14
15
18
19
22
23
24
1 Mile
5 000 Feet
Scale 1:15 840


N
(Joins sheet 72)
R. 2 W.
(Joins sheet 79)
(Joins sheet 88)
T. 92 N.
1 Mile
5 000 Feet
Scale 1:15 840
2 640 000 FEET
GUTTENBERG
U.S. LOCK AND DAM NO. 10
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
MISSISSIPPI RIVER
Miners Creek
Swift Slough
Big Pond
ISLAND
189
Cassville Slough
GRANT COUNTY
WISCONSIN
Ackerman Cut
Goetz Island
water
16
17
18
19
20
21


N
R. 6 W
(Joins sheet 73)
(Joins sheet 82)
(Joins sheet 89)
T 92 N
FAYETTE COUNTY
Howell Creek
2 510 000 FEET
2 525 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840

CLAYTON COUNTY, IOWA — SHEET NUMBER 82

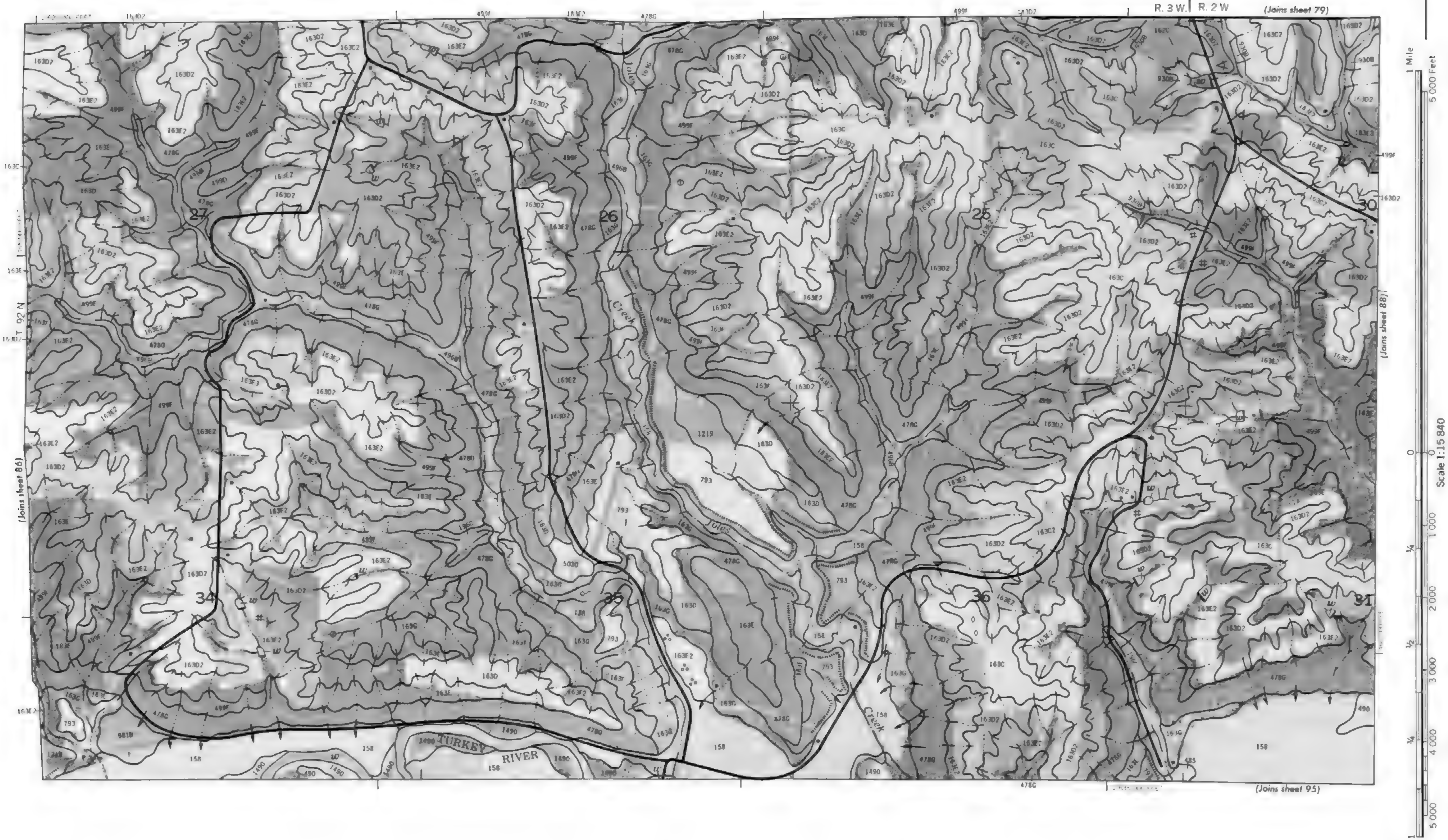


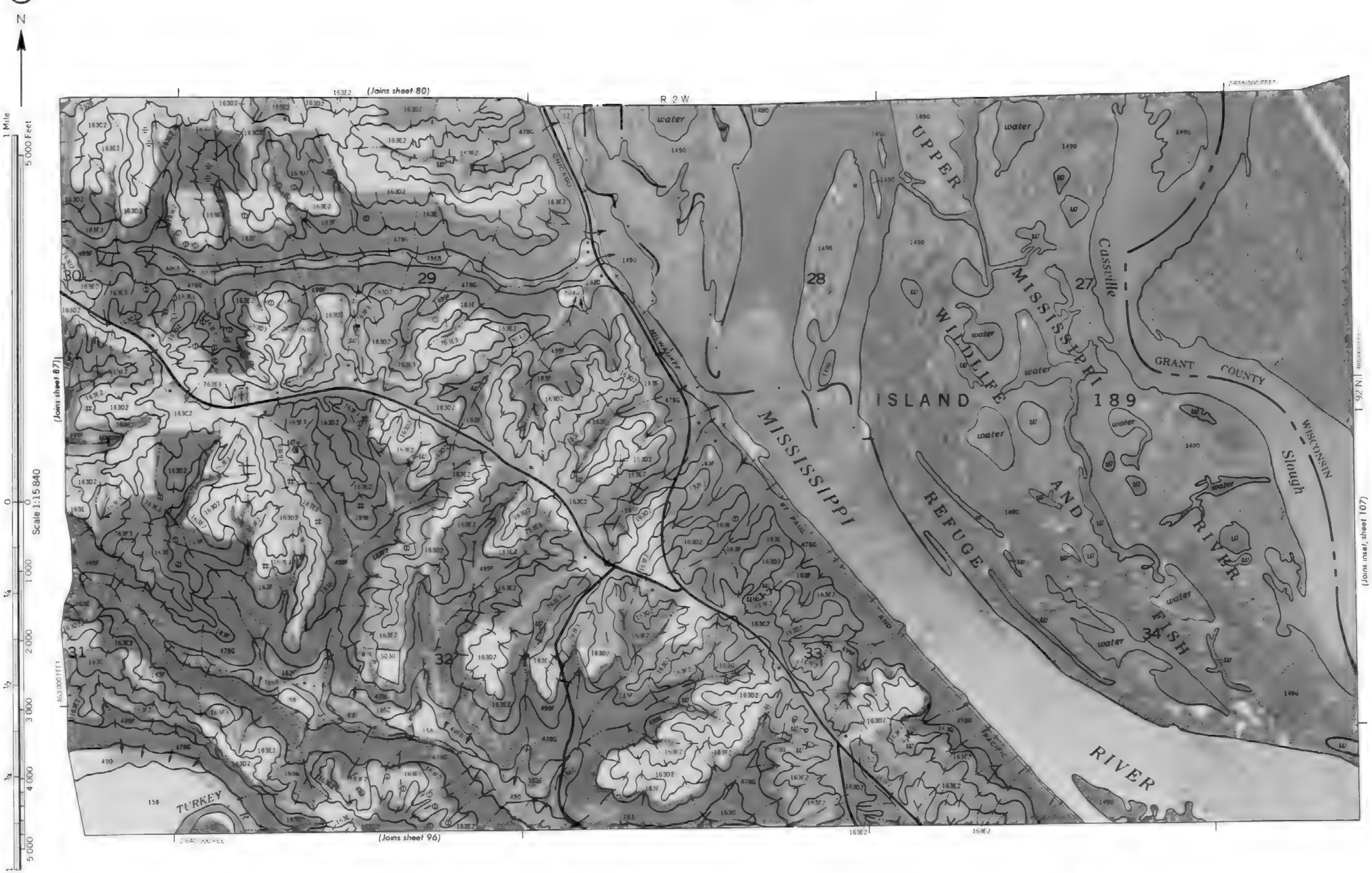

N
R. 5 W
(Joins sheet 75)
(Joins sheet 84)
(Joins sheet 91)
(Joins sheet 82)
T. 92 N.
VOLGA
RIVER
Honey
Creek
28
29
27
26
32
33
34
35
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 76)
(Joins sheet 83)
(Joins sheet 85)
(Joins sheet 92)
R 5 W.
R 4 W.
T. 92 N
Littleport
VOLGA
RIVER
Honey
Creek
Creek
Creek
25
26
30
29
31
32
35
36


85
N
R 4 W.
(Joins sheet 77)
(Joins sheet 86)
(Joins sheet 93)
(Joins sheet 84)
T 92 N
28
27
26
25
33
34
35
36
VOLGA
VOLGA
RIVER
TURKEY
RIVER
RIVER
Creek
Creek
Bear
Elkport
Garber
1 Mile
5 000 Feet
Scale 1:15 840
10 000 FEET

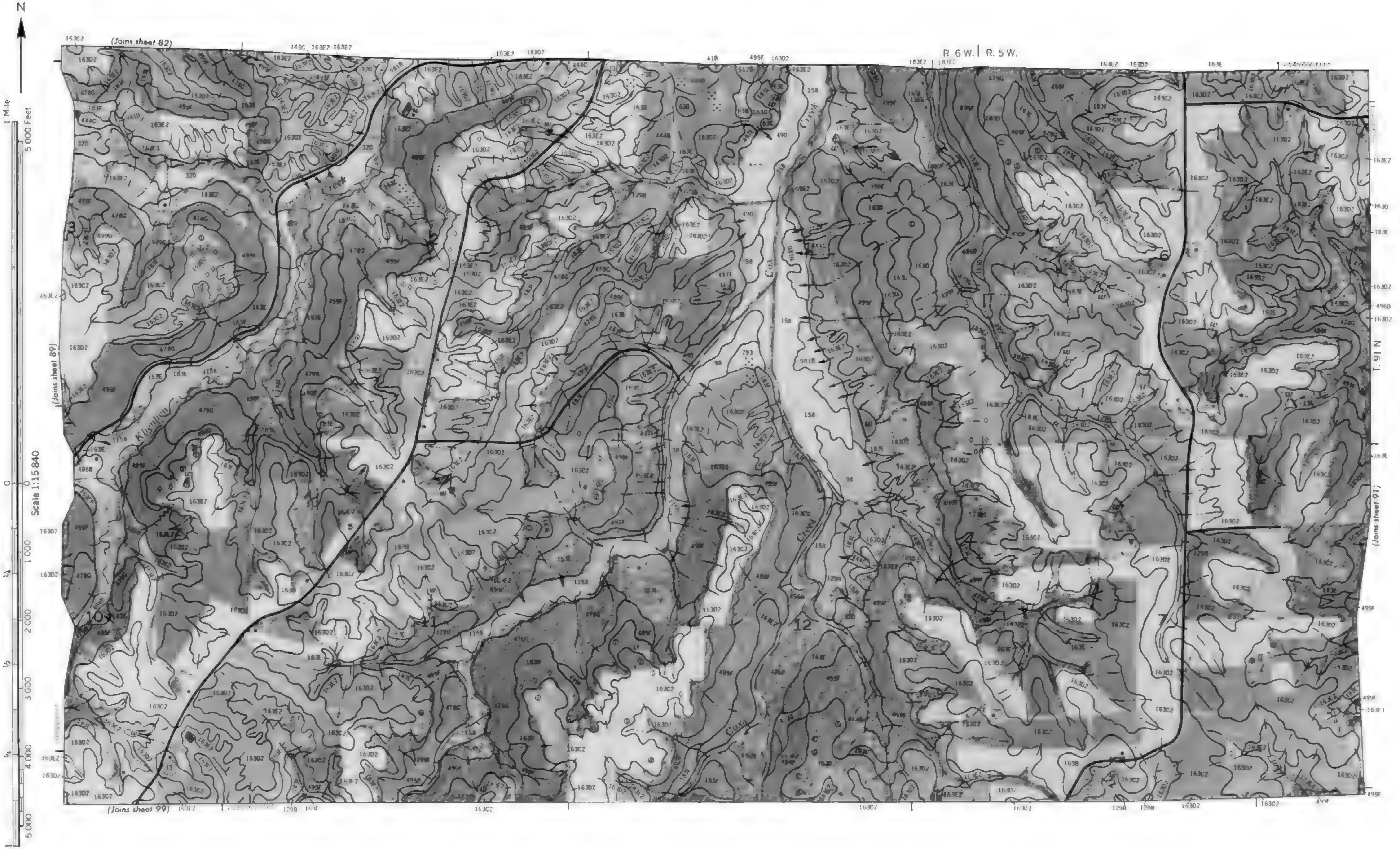

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 78)
R. 4 W. | R. 3 W.
(Joins sheet 85)
(Joins sheet 87)
(Joins sheet 94)
T. 92 N.
TURKEY
RIVER
South
Cedar
Creek
25
30
29
28
36
31
32
33


87
N
R. 3 W. | R. 2 W
(Joins sheet 79)
(Joins sheet 86)
(Joins sheet 88)
(Joins sheet 95)
T. 92 N.
27
26
25
30
34
35
36
31
Creek
Joles
TURKEY
RIVER
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾

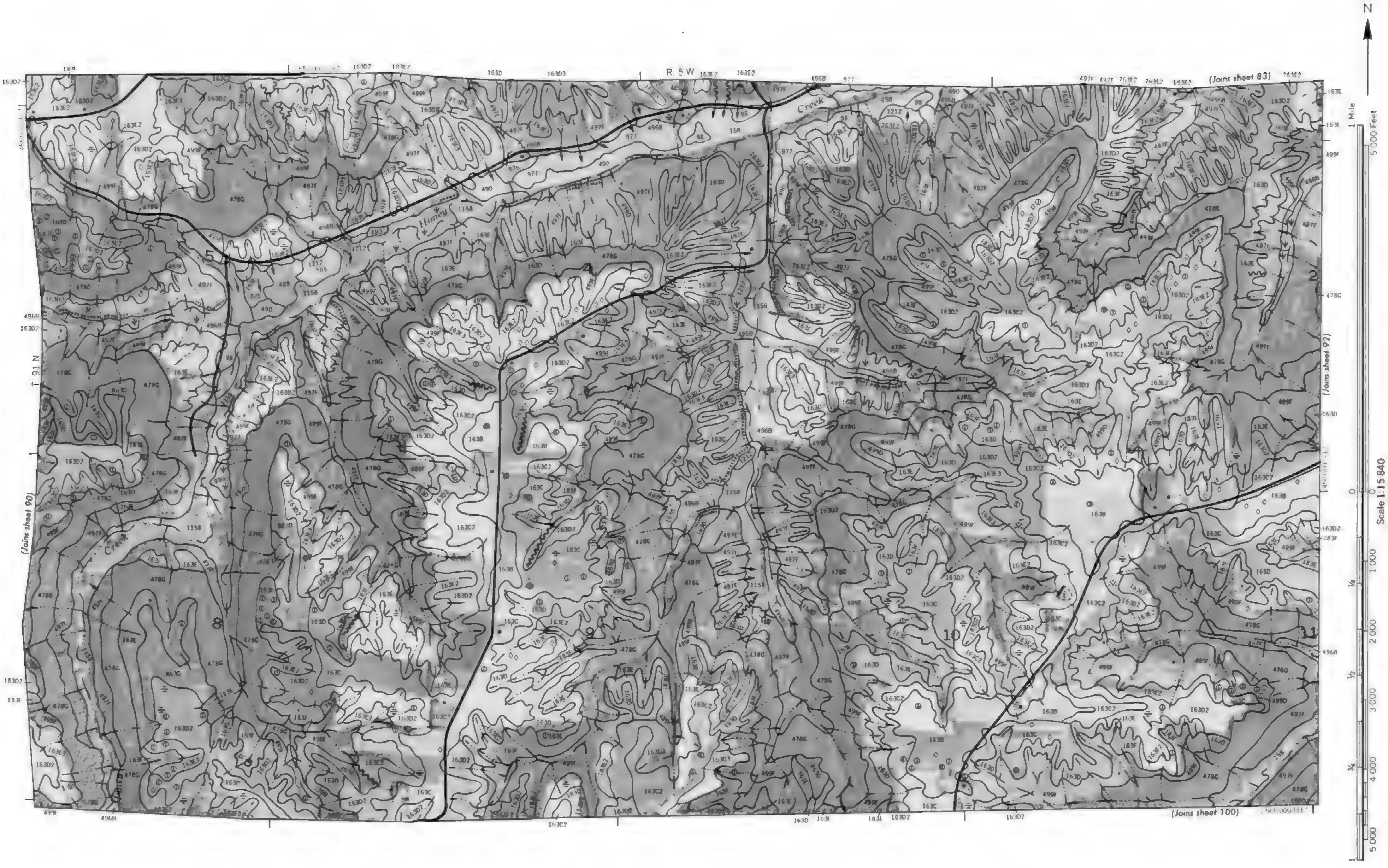

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 80)
(Joins sheet 87)
(Joins sheet 96)
(Joins inset, sheet 107)
R 2 W
T 92 N
UPPER MISSISSIPPI WILDLIFE AND FISH REFUGE
MISSISSIPPI RIVER
ISLAND 189
GRANT COUNTY
WISCONSIN
Cassville Slough
TURKEY
CHICAGO MILWAUKEE ST PAUL AND PACIFIC
29
28
27
30
31
32
33
34
water


N
R. 6 W
T 91 N
FAYETTE COUNTY
(Joins sheet 81)
(Joins sheet 90)
(Joins sheet 98)
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1
4
5
6
7
8
9
10

CLAYTON COUNTY, IOWA — SHEET NUMBER 90

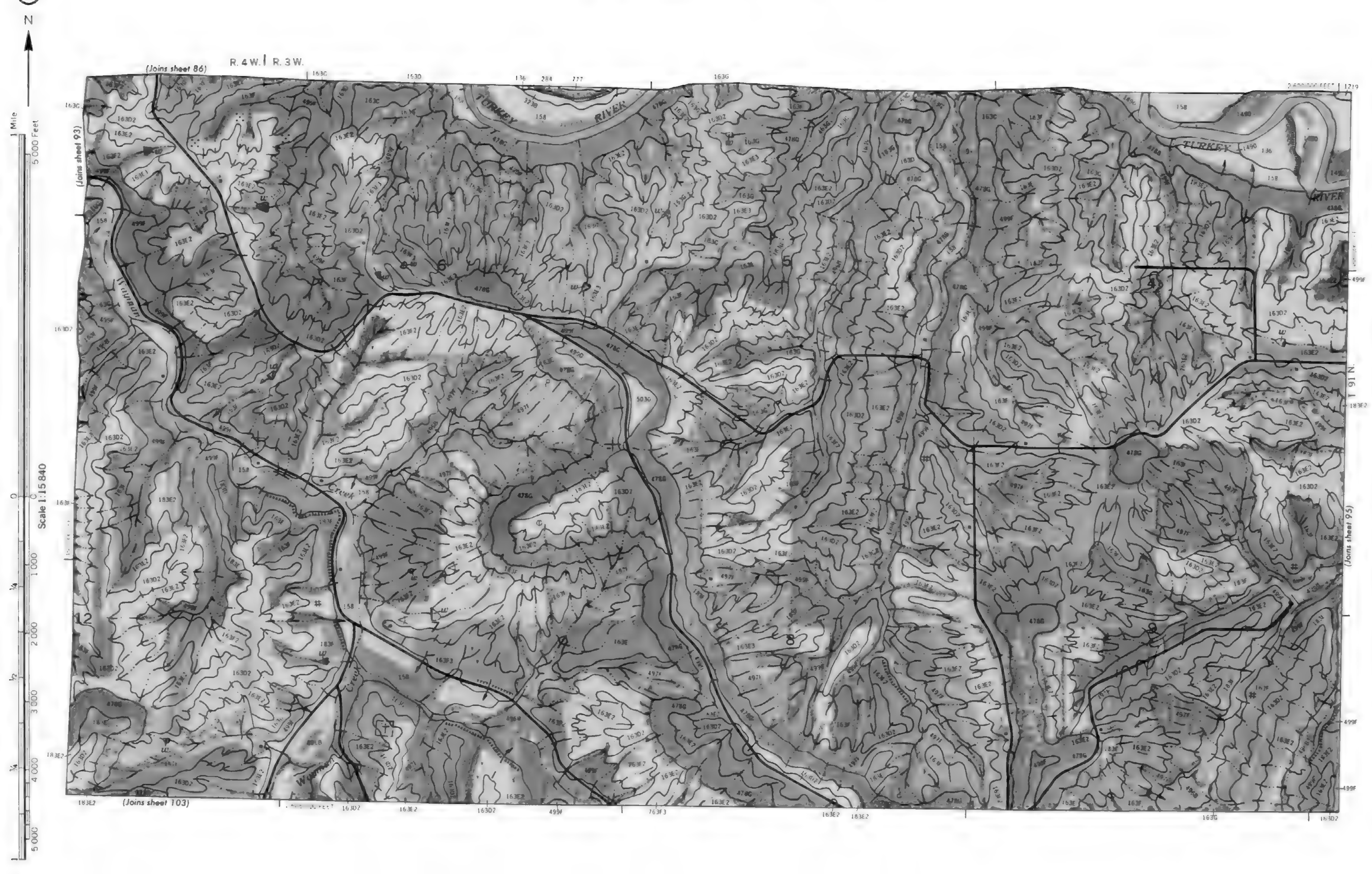


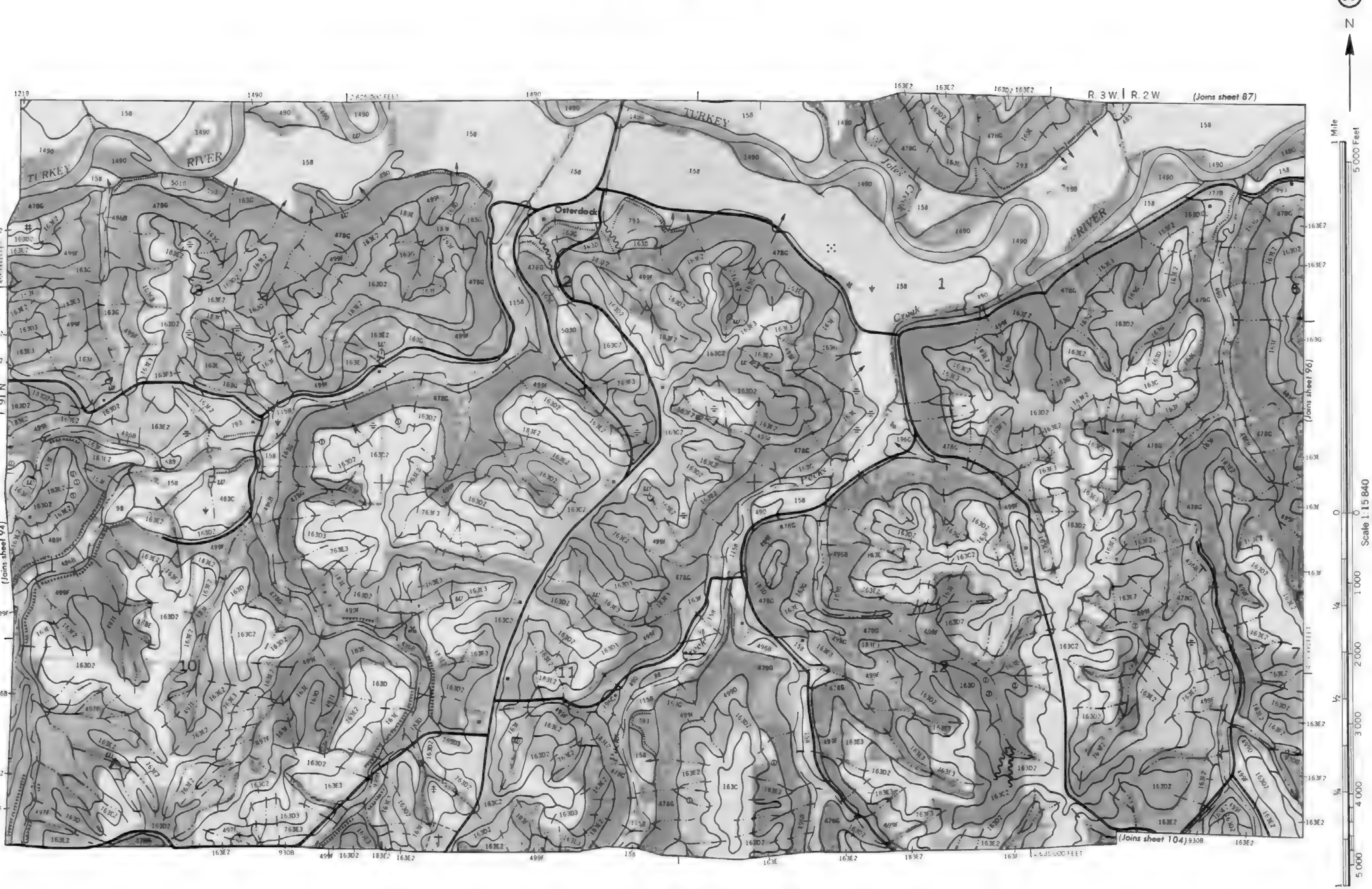
91


R. 5 W
T 91 N
(Joins sheet 83)
(Joins sheet 92)
(Joins sheet 100)
(Joins sheet 90)
Honey
Creek
Creek
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5 000
¼
½
¾

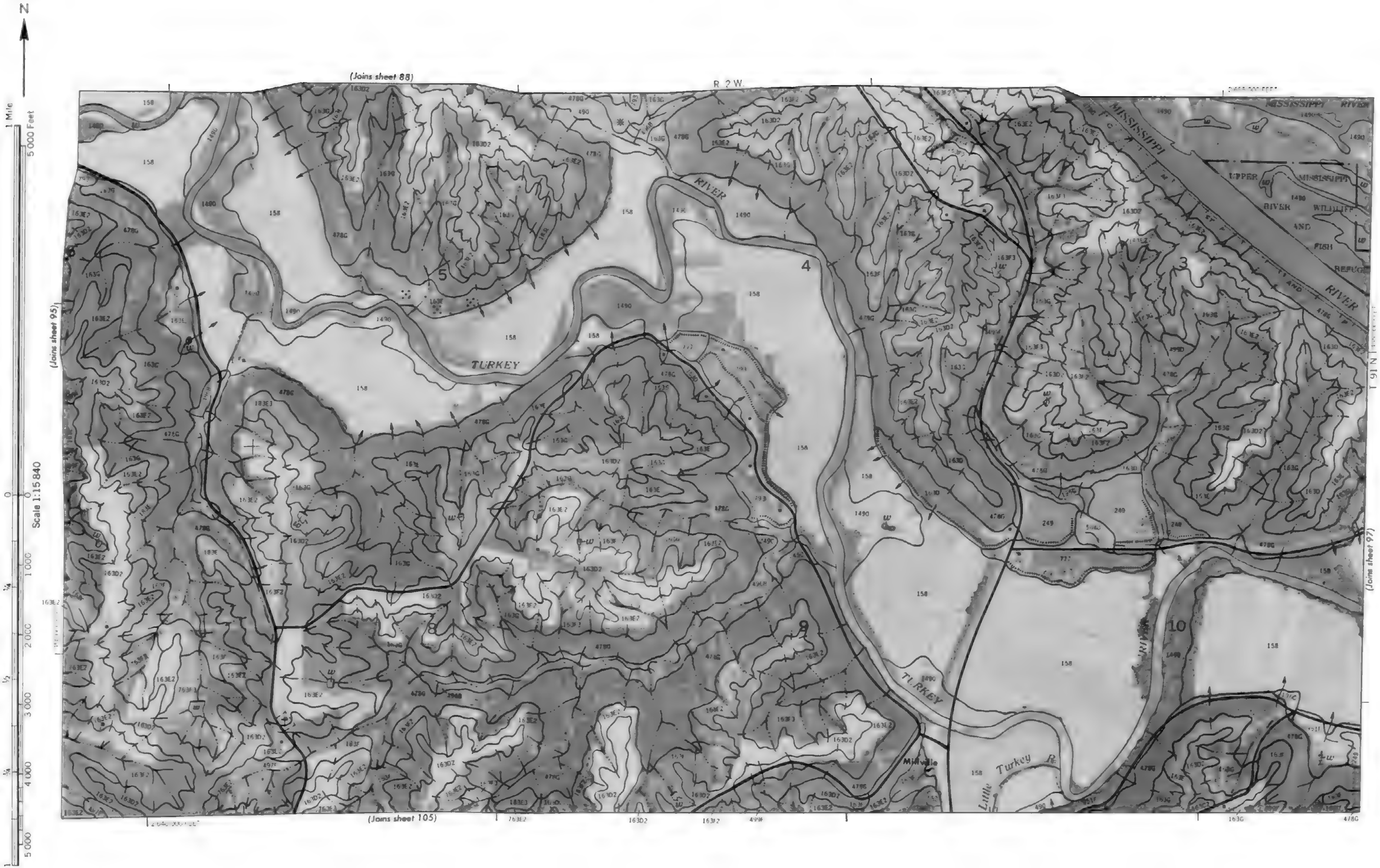

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 84)
R. 5 W.
R. 4 W.
(Joins sheet 97)
T. 91 N.
(Joins sheet 93)
(Joins sheet 101)
Creek
Bear
Creek

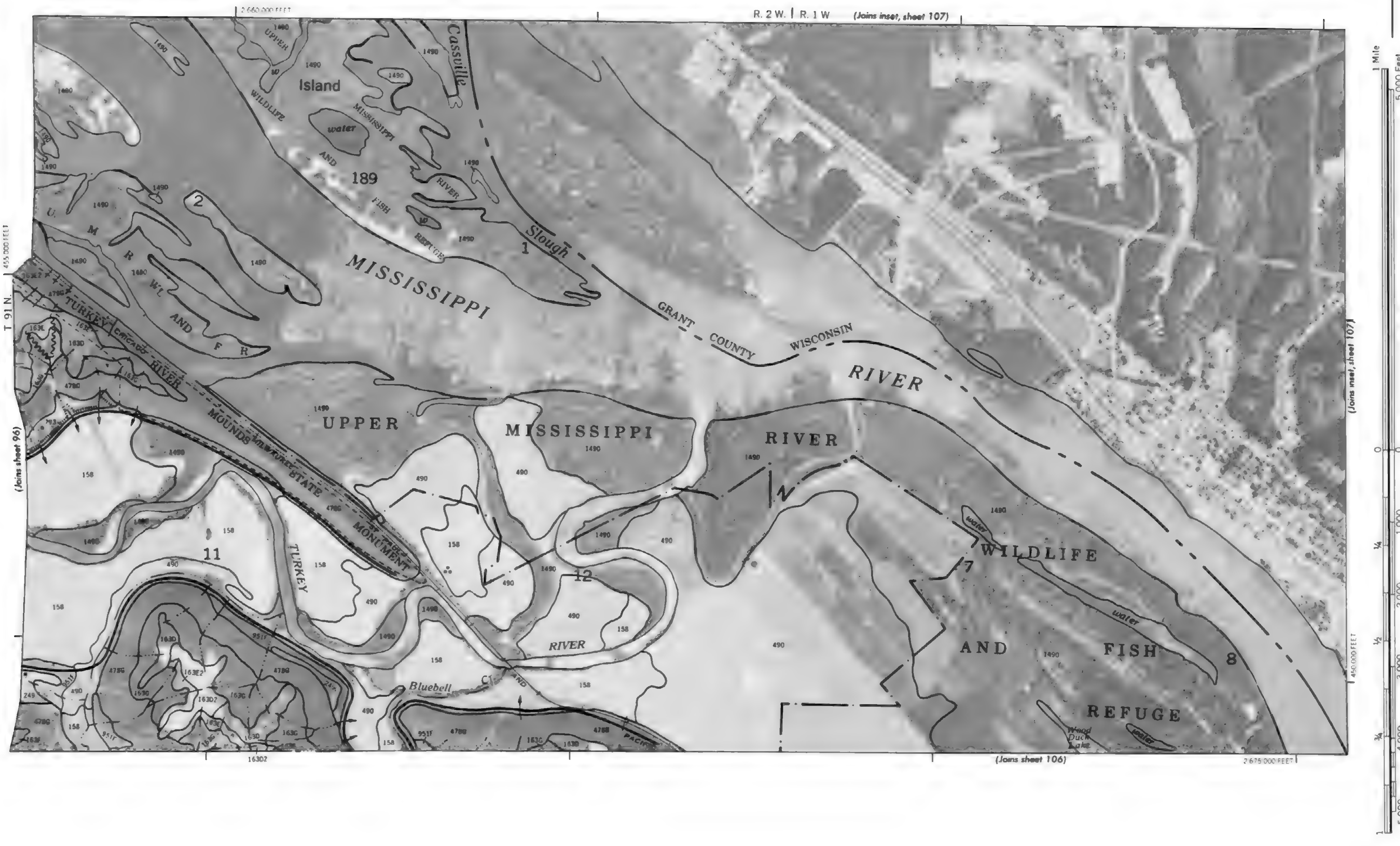

N
R 4 W.
T 91 N
(Joins sheet 85)
(Joins sheet 94)
(Joins sheet 102)
(Joins sheet 92)
Elk Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾

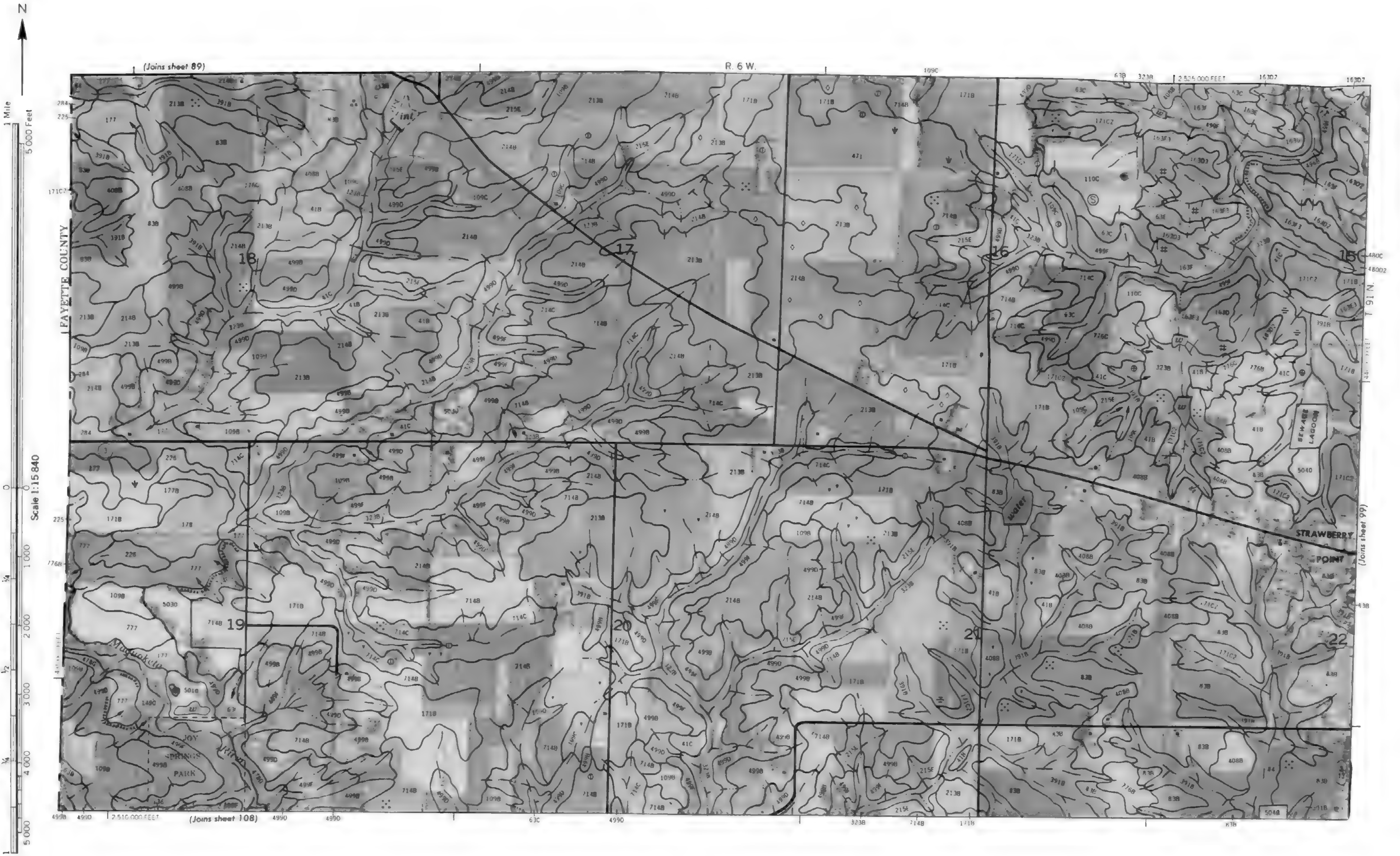

94
N
(Joins sheet 86)
R. 4 W. | R. 3 W.
(Joins sheet 93)
(Joins sheet 95)
(Joins sheet 103)
TURKEY RIVER
TURKEY
RIVER
T. 91 N.
Scale 1:15 840
1 Mile
5 000 Feet


95
N
R. 3 W. | R. 2 W.
(Joins sheet 87)
(Joins sheet 96)
(Joins sheet 94)
(Joins sheet 104)
T. 91 N.
TURKEY RIVER
Osterdock
Joles Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾

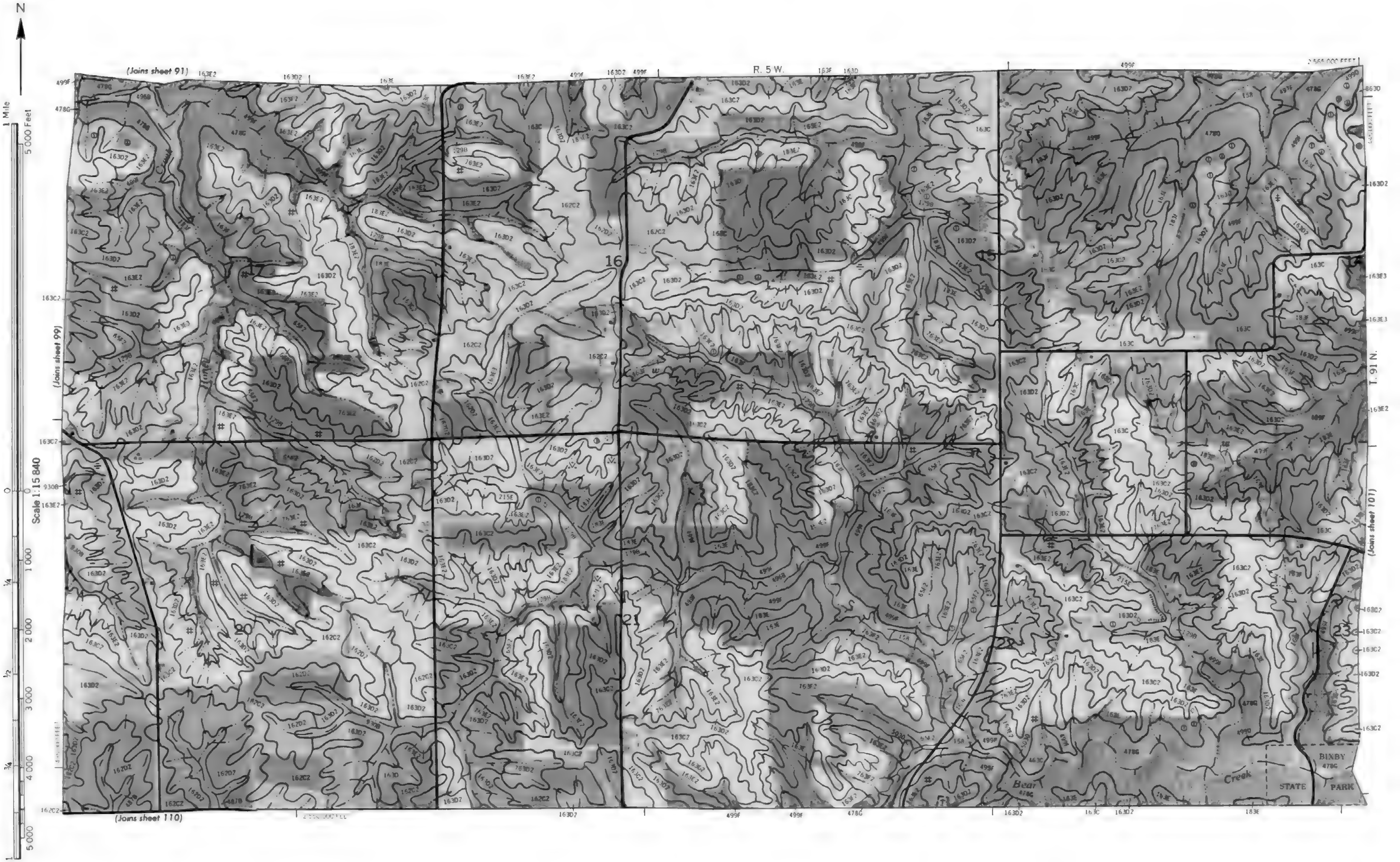
CLAYTON COUNTY, IOWA — SHEET NUMBER 96




97
N
R. 2 W. | R. 1 W
(Joins inset, sheet 107)
T. 91 N.
(Joins sheet 96)
(Joins inset, sheet 107)
(Joins sheet 106)
2 660 000 FEET
455 000 FEET
450 000 FEET
2 675 000 FEET
Island
water
189
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
Cassville
Slough
MISSISSIPPI
GRANT COUNTY WISCONSIN
RIVER
UPPER MISSISSIPPI RIVER
WILDLIFE AND FISH REFUGE
TURKEY RIVER
MOUNDS STATE MONUMENT
TURKEY
RIVER
Bluebell
Wood Duck Lake
11
12
7
8
1
2
Scale 1:15 840
1 Mile
5 000 Feet

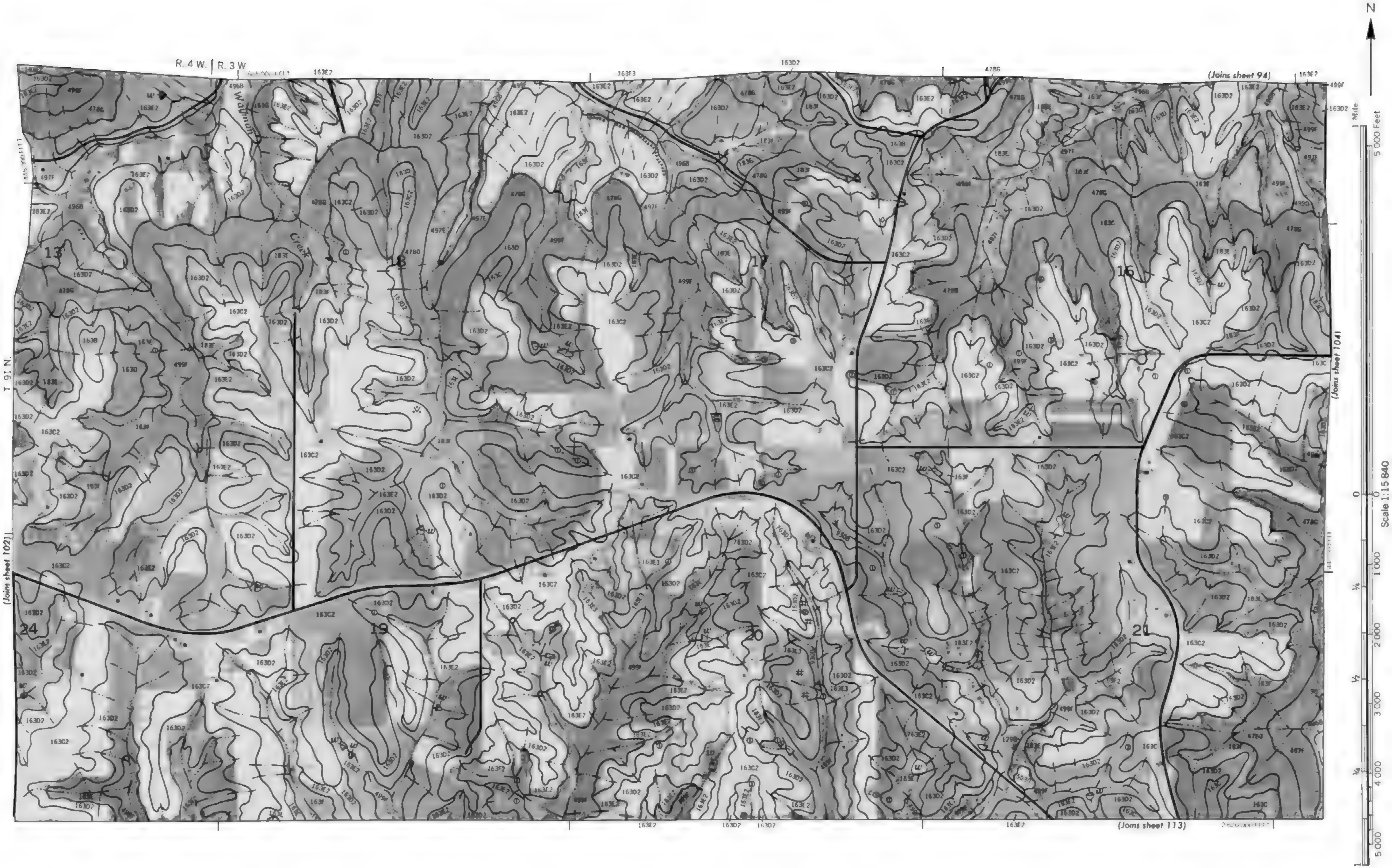

N
(Joins sheet 89)
R. 6 W.
2 525 000 FEET
LAFAYETTE COUNTY
T. 91 N.
(Joins sheet 99)
(Joins sheet 108)
2 510 000 FEET
STRAWBERRY POINT
SEWAGE LAGOON
Water
Maquoketa River
JOY SPRINGS PARK
18
17
16
15
19
20
21
22
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000


N
R 6 W | R 5 W.
(Joins sheet 90)
(Joins sheet 100)
(Joins sheet 98)
(Joins sheet 109)
T 91 N
STRAWBERRY POINT
15
14
13
18
22
23
24
19
2 045 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 91)
R. 5 W.
T. 91 N.
(Joins sheet 99)
(Joins sheet 101)
(Joins sheet 110)
16
15
14
20
21
22
23
Bear
Creek
BIXBY
STATE
PARK


101
N
(Joins sheet 92)
R. 5 W. | R. 4 W.
T. 91 N.
(Joins sheet 100)
(Joins sheet 102)
(Joins sheet 111)
Doe
Creek
Bear
Creek
Cr.
water
BIXBY
STATE
PARK
13
14
17
18
19
20
23
24
2 580 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000

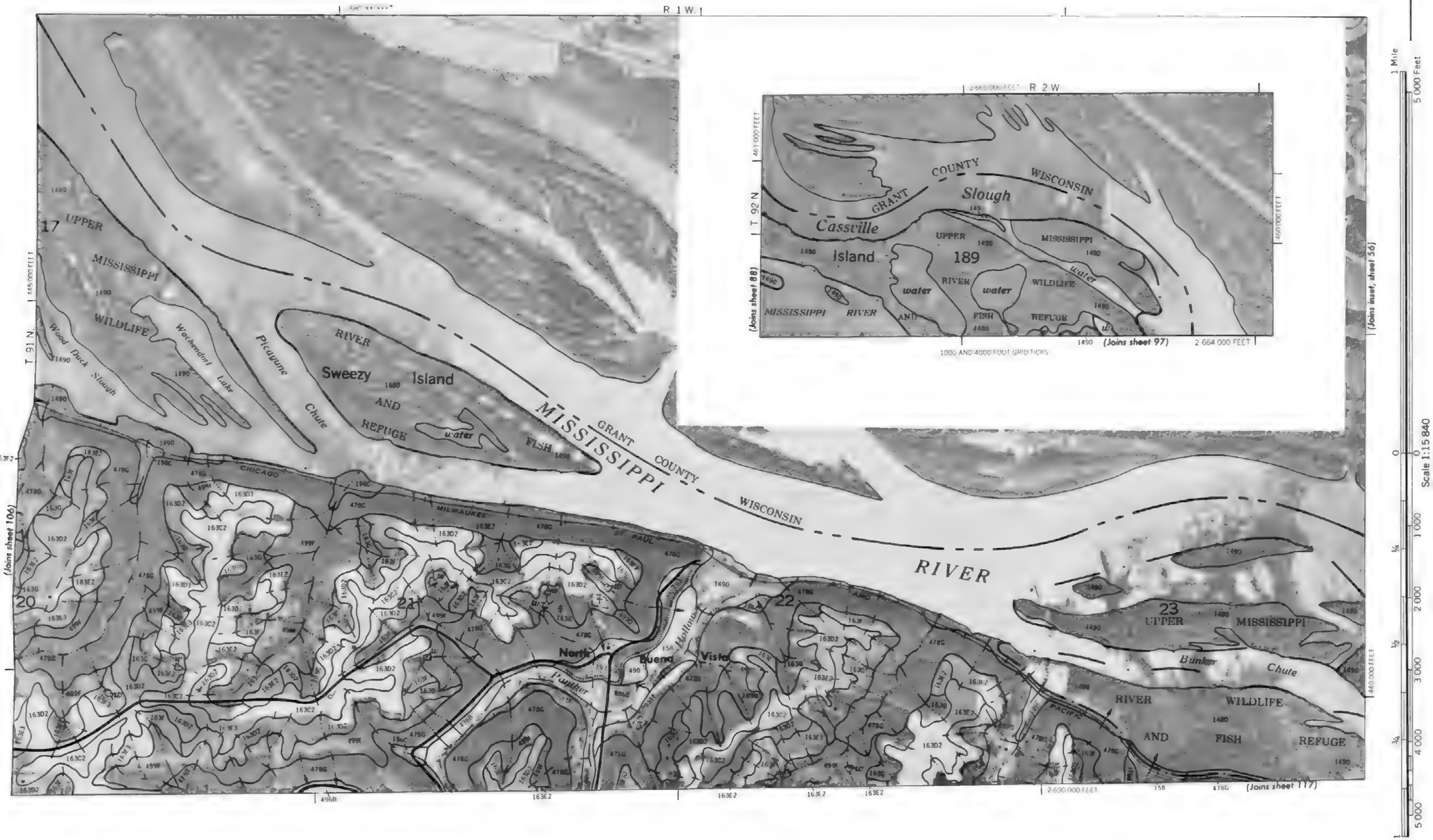

N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
1/4
2 000
1/2
3 000
3/4
4 000
5 000
(Joins sheet 93)
(Joins sheet 101)
(Joins sheet 103)
(Joins sheet 112)
R. 4 W.
T. 91 N.
Elk Creek
16
15
14
13
21
22
23
24

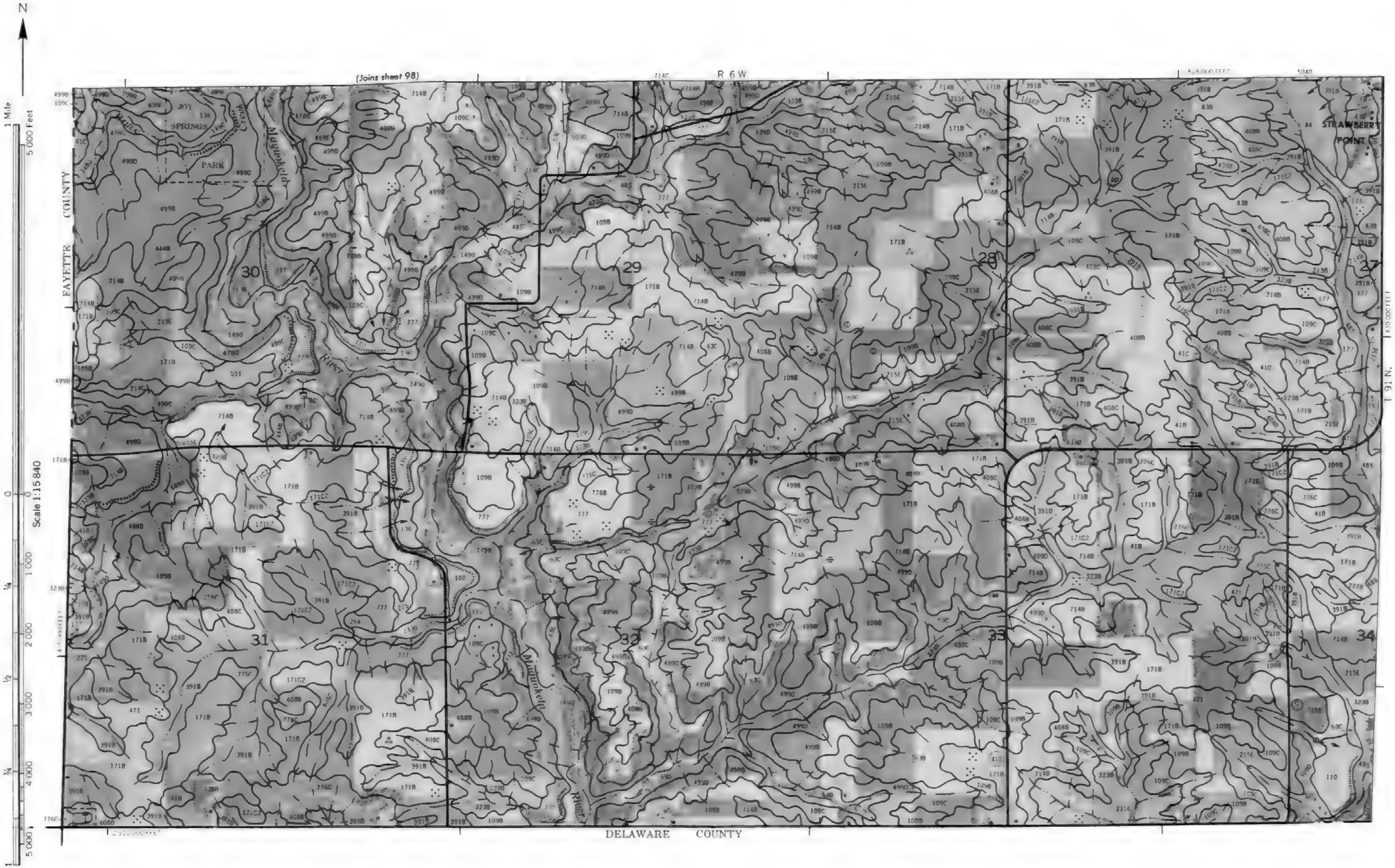

N
R. 4 W.
R. 3 W.
T. 91 N.
(Joins sheet 94)
(Joins sheet 104)
(Joins sheet 113)
(Joins sheet 102)
Waukum Creek
13
18
17
16
24
19
20
21
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾

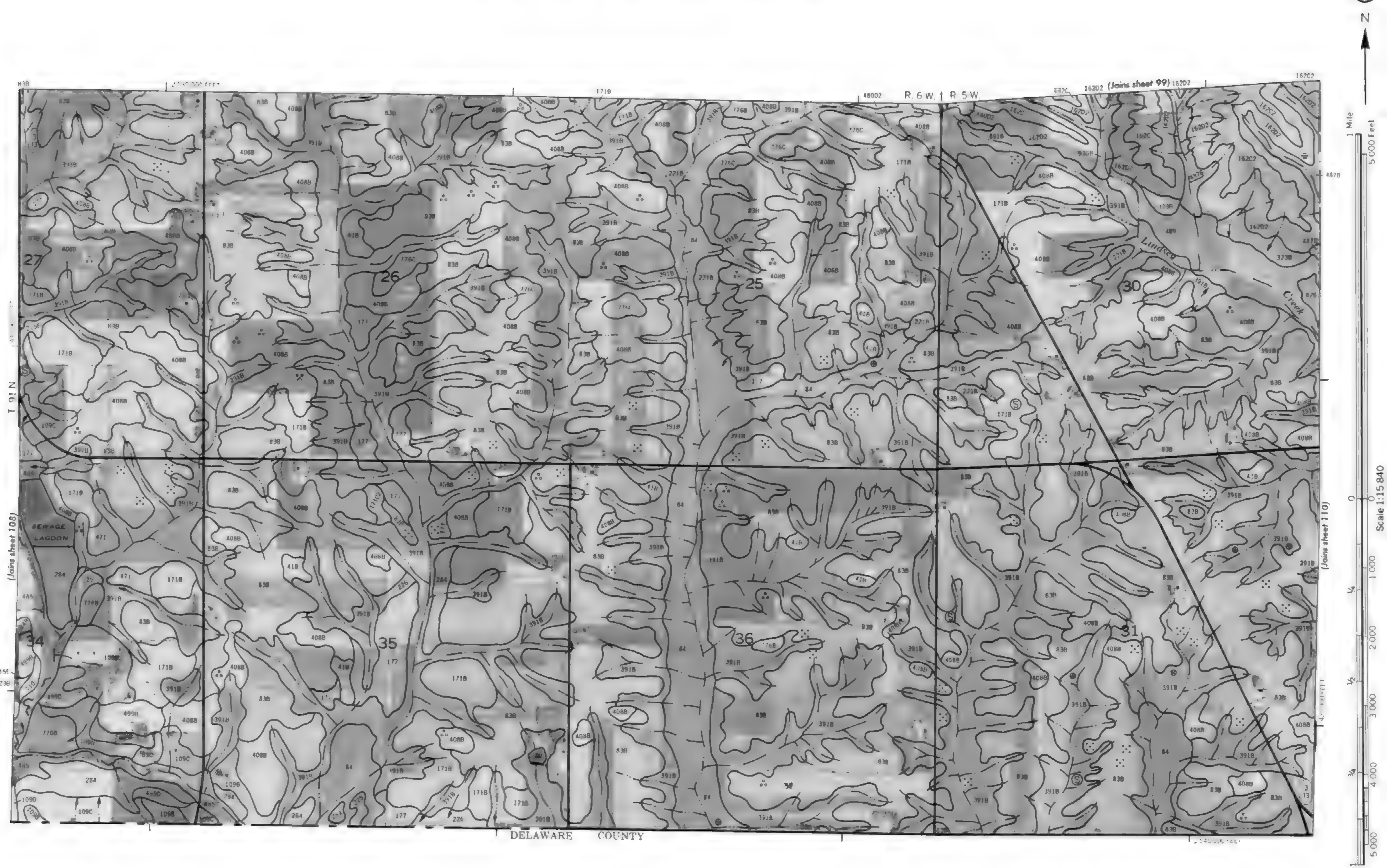

N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
(Joins sheet 95)
(Joins sheet 103)
(Joins sheet 105)
(Joins sheet 114)
R. 3 W.
R. 2 W.
T. 91 N.
Pecks Creek
Creek
Turkey River
14
15
13
18
22
23
24
19

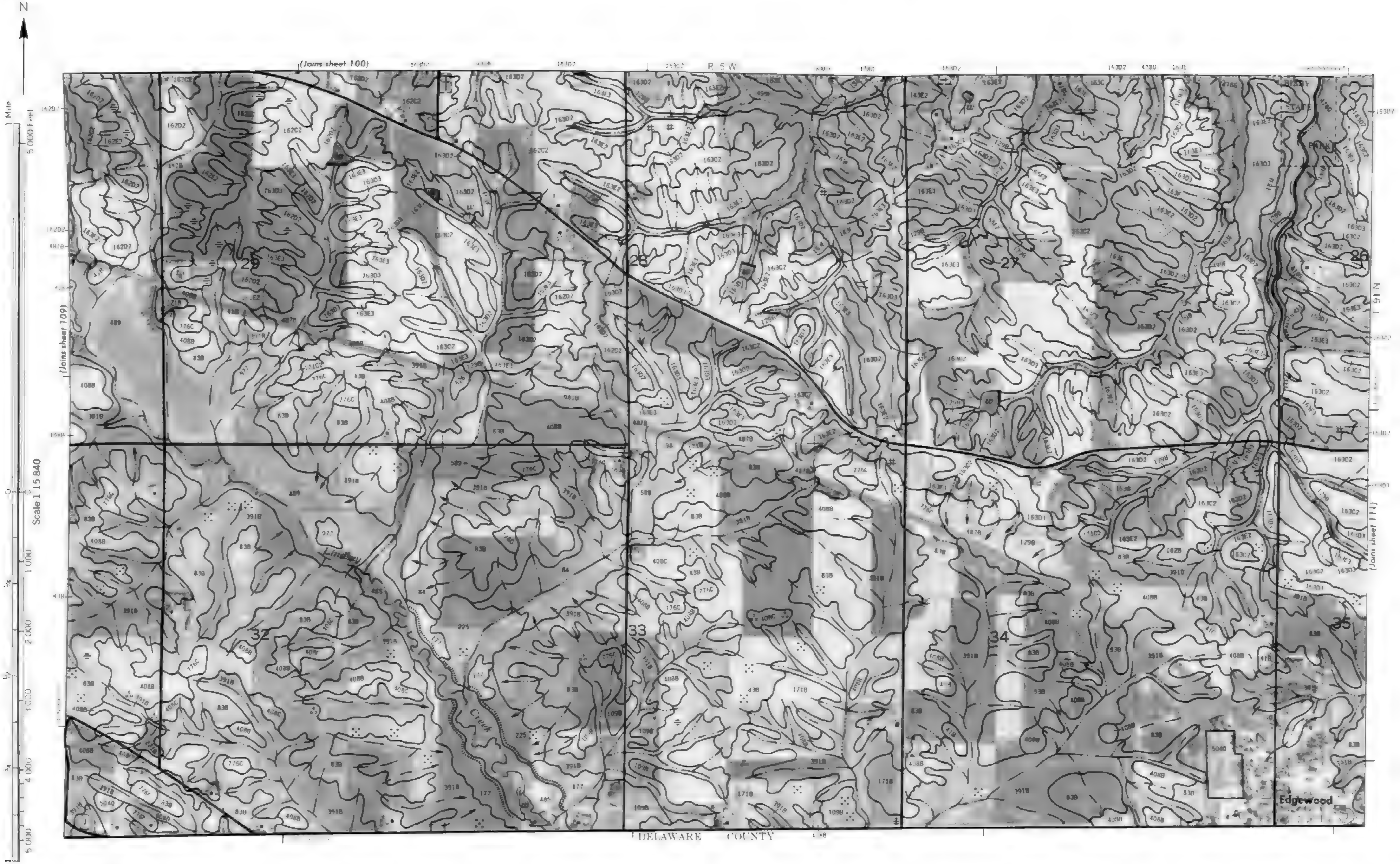

N
R. 2 W
T. 91 N
(Joins sheet 96)
(Joins sheet 104)
(Joins sheet 106)
(Joins sheet 115)
Little
River
Turkey
Turkey
River
1 Mile
5 000 Feet
Scale 1:15 840

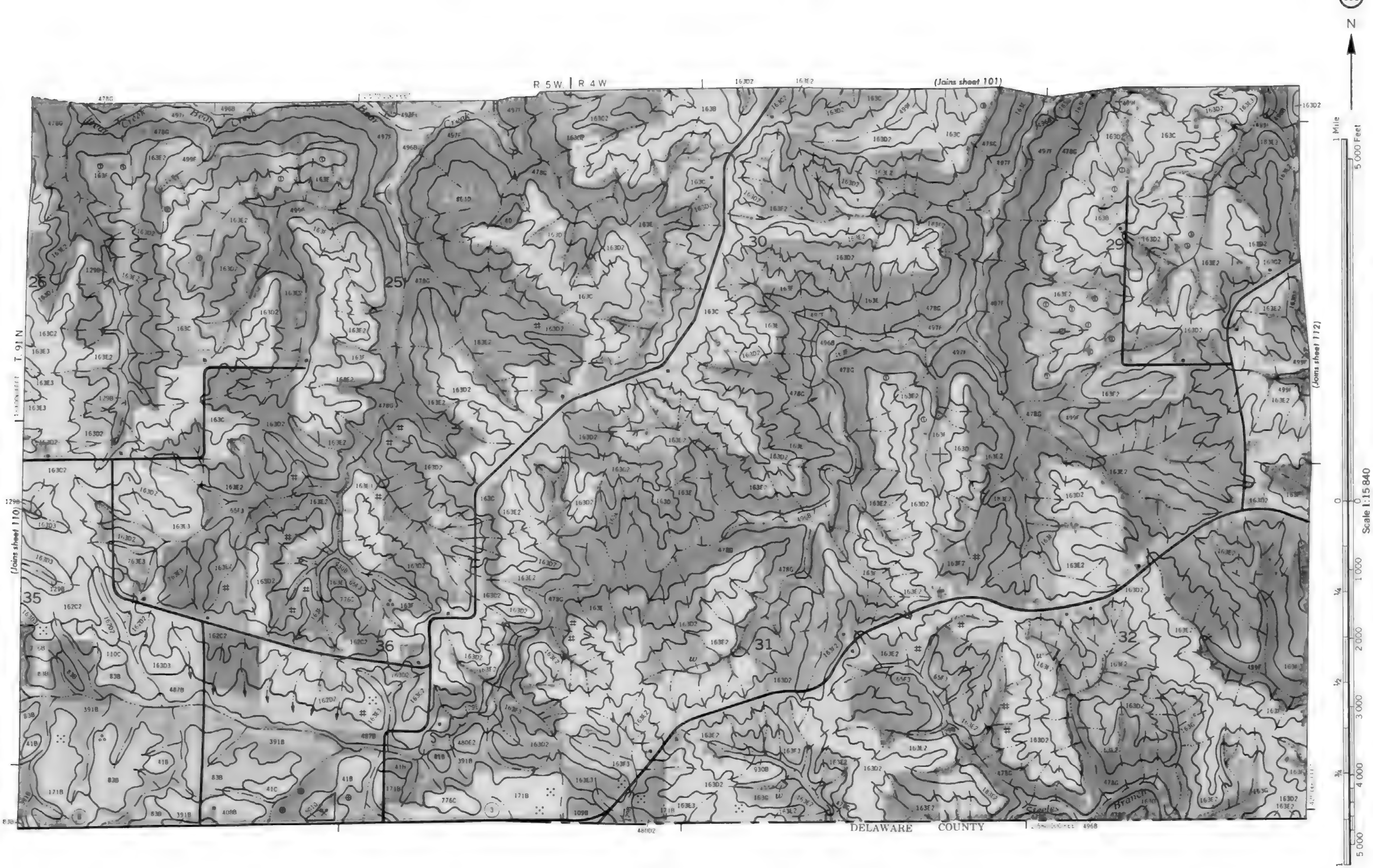

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 97)
R. 2 W.
R. 1 W.
2 675 000 FEET
UPPER
MISSISSIPPI
RIVER
WILDLIFE
AND
FISH
REFUGE
MISSISSIPPI RIVER
Spring Lake
Dead Lake
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
Bluebell Creek
14
13
18
17
23
24
19
20
T. 91 N.
(Joins sheet 105)
(Joins sheet 107)
(Joins sheet 116)


107
N
R 1 W.
R 2 W
T 92 N
T 91 N.
MISSISSIPPI
RIVER
GRANT COUNTY
WISCONSIN
Cassville
Slough
Island
189
Sweezy
Island
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
Wood Duck Slough
Wachendorf Lake
Picayune Chute
Bunker Chute
water
CHICAGO MILWAUKEE ST. PAUL PACIFIC
North Buena Vista
Panther
Hollow
17
20
21
22
23
(Joins sheet 106)
(Joins sheet 88)
(Joins sheet 97)
(Joins sheet 117)
(Joins inset, sheet 56)
1000 AND 4000 FOOT GRID TICKS
2 664 000 FEET
2 690 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840

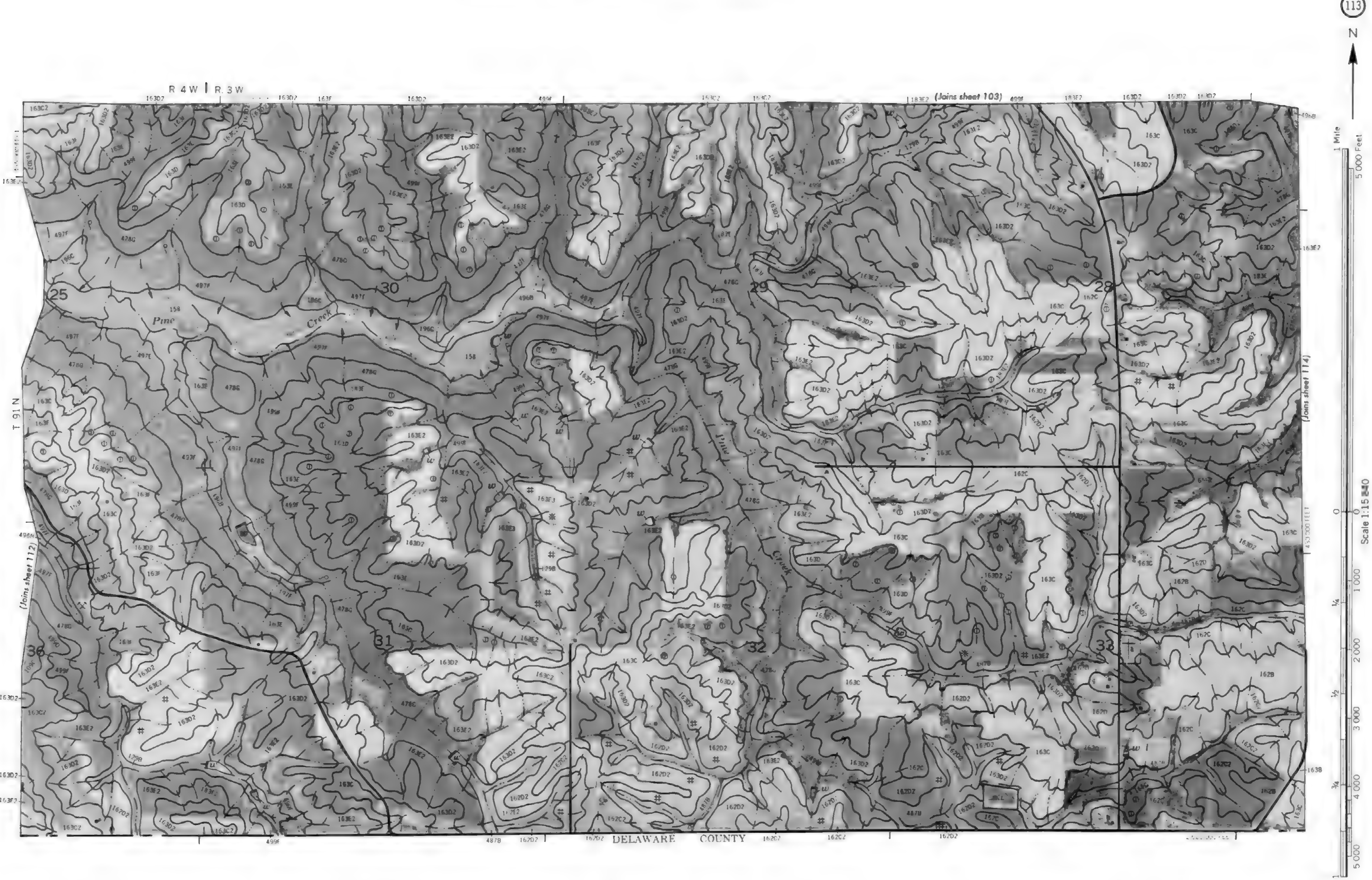

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 98)
R. 6 W.
T. 91 N.
FAYETTE COUNTY
DELAWARE COUNTY
JOY SPRINGS PARK
STRAWBERRY POINT
Maquoketa River
30
29
28
27
31
32
33
34


N
(Joins sheet 99)
R. 6 W.
R. 5 W.
T. 91 N.
(Joins sheet 108)
(Joins sheet 110)
SEWAGE
LAGOON
Lindsey
Creek
27
26
25
30
34
35
36
31
DELAWARE COUNTY
1 Mile
5 000 Feet
Scale 1:15 840

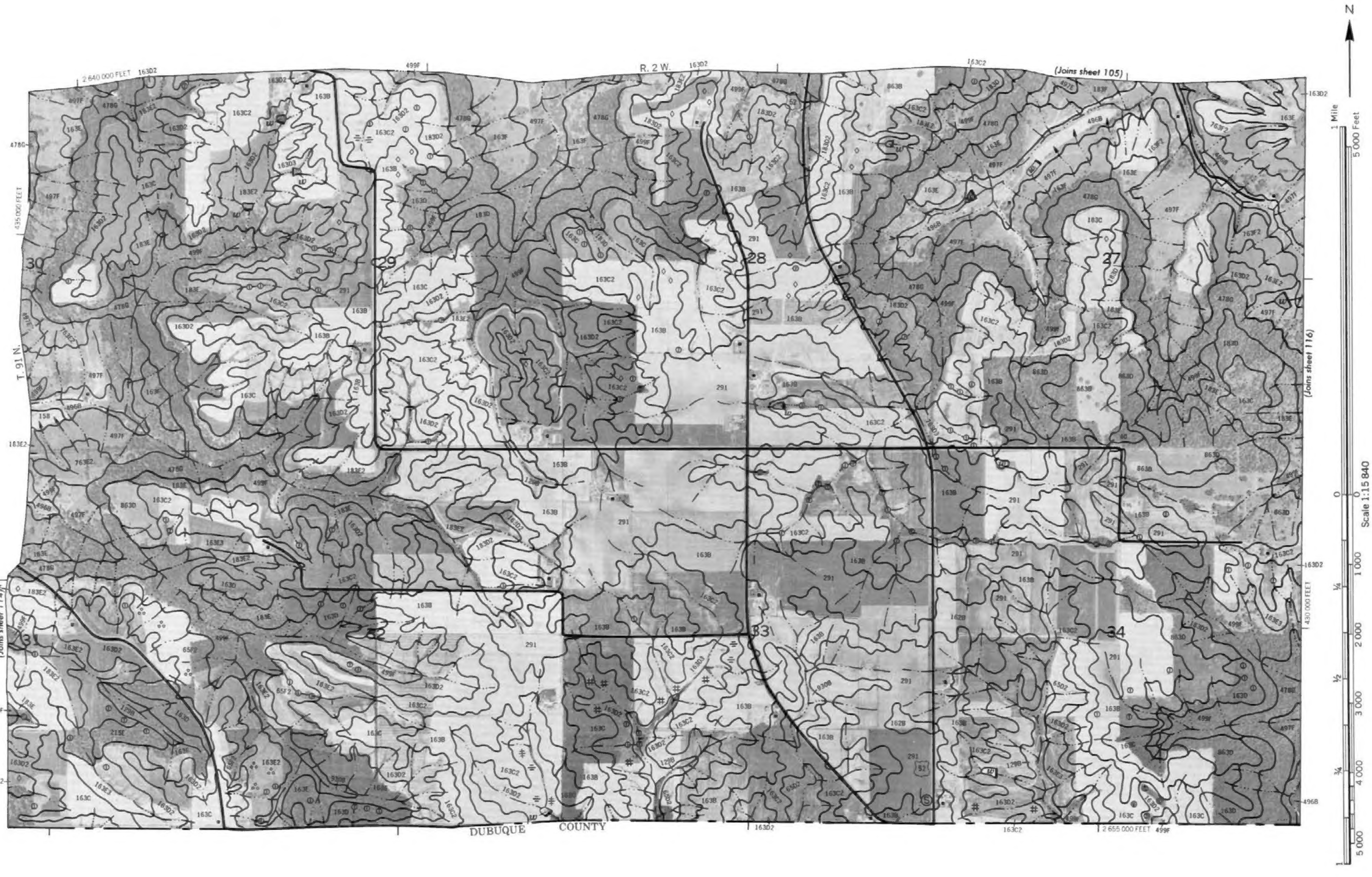

N
(Joins sheet 100)
R. 5 W.
(Joins sheet 109)
(Joins sheet 111)
T. 91 N.
29
28
27
26
32
33
34
35
Lindsey
Creek
DELAWARE COUNTY
Edgewood
1 Mile
5 000 Feet
Scale 1:15 840


111
N
R 5 W.
R 4 W
(Joins sheet 101)
(Joins sheet 112)
(Joins sheet 110)
T. 91 N
25
26
29
30
31
32
35
36
Bear Creek
DELAWARE COUNTY
1 Mile
5 000 Feet
Scale 1:15 840

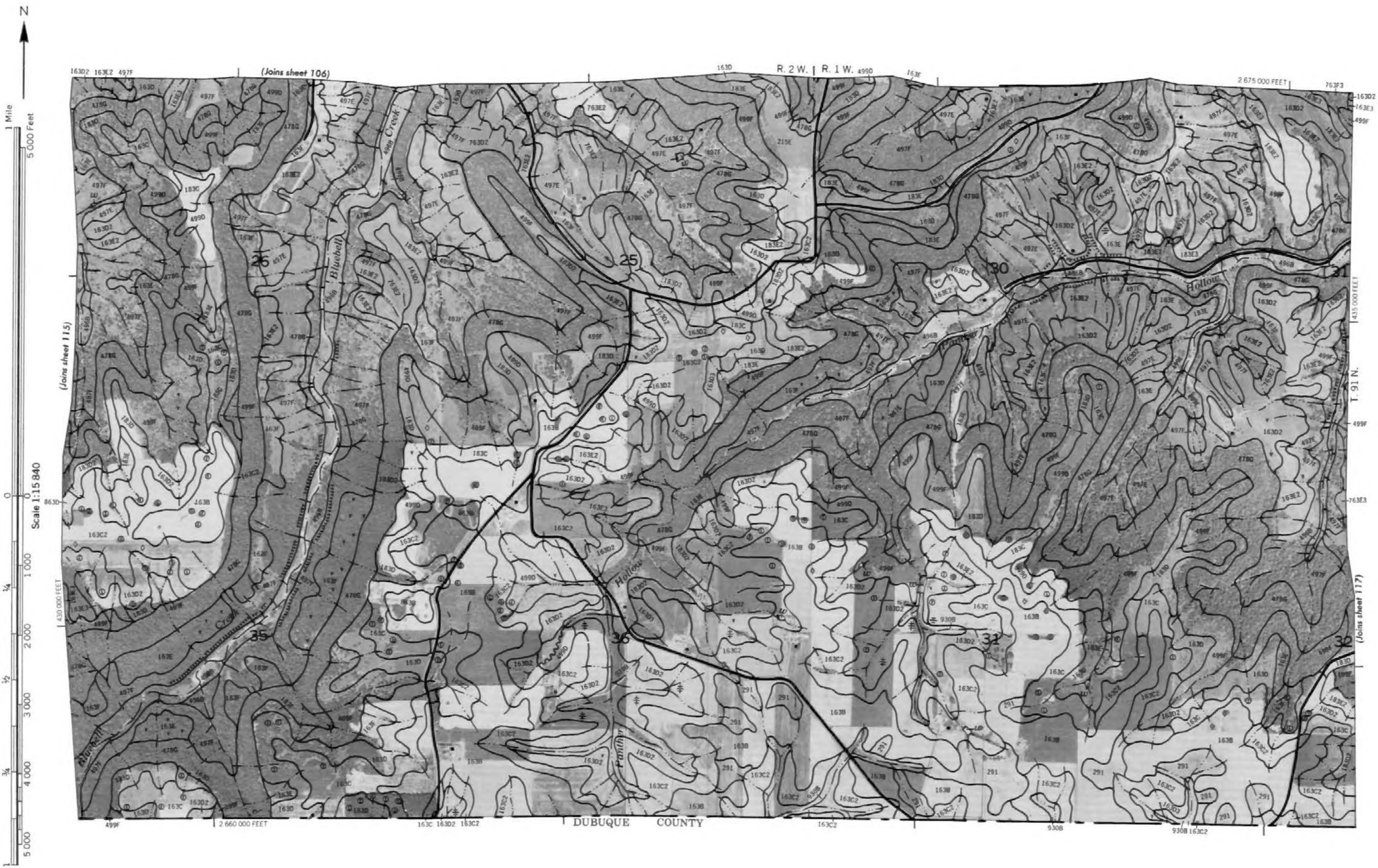

N
(Joins sheet 102)
R 4 W
(Joins sheet 111)
(Joins sheet 113)
T 91 N
28
26
25
33
34
35
36
Pine
Creek
Branch
Steeles
Creek
DELAWARE COUNTY
Scale 1:15 840
1 Mile
5 000 Feet

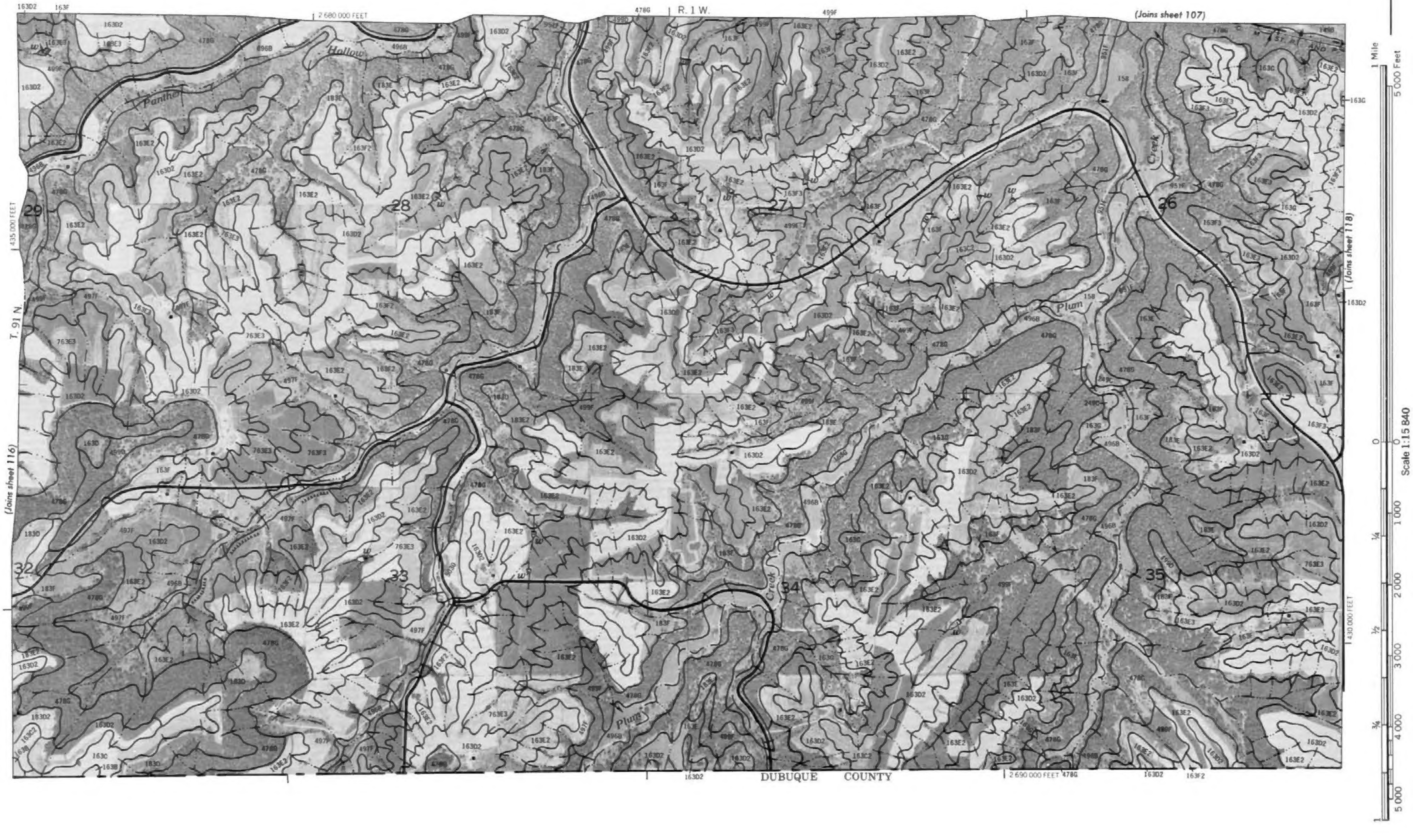

113
N
R 4 W
R 3 W
(Joins sheet 103)
(Joins sheet 112)
(Joins sheet 114)
T 91 N
25
30
29
28
36
31
32
33
Pine
Creek
Pine
Creek
DELAWARE COUNTY
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1

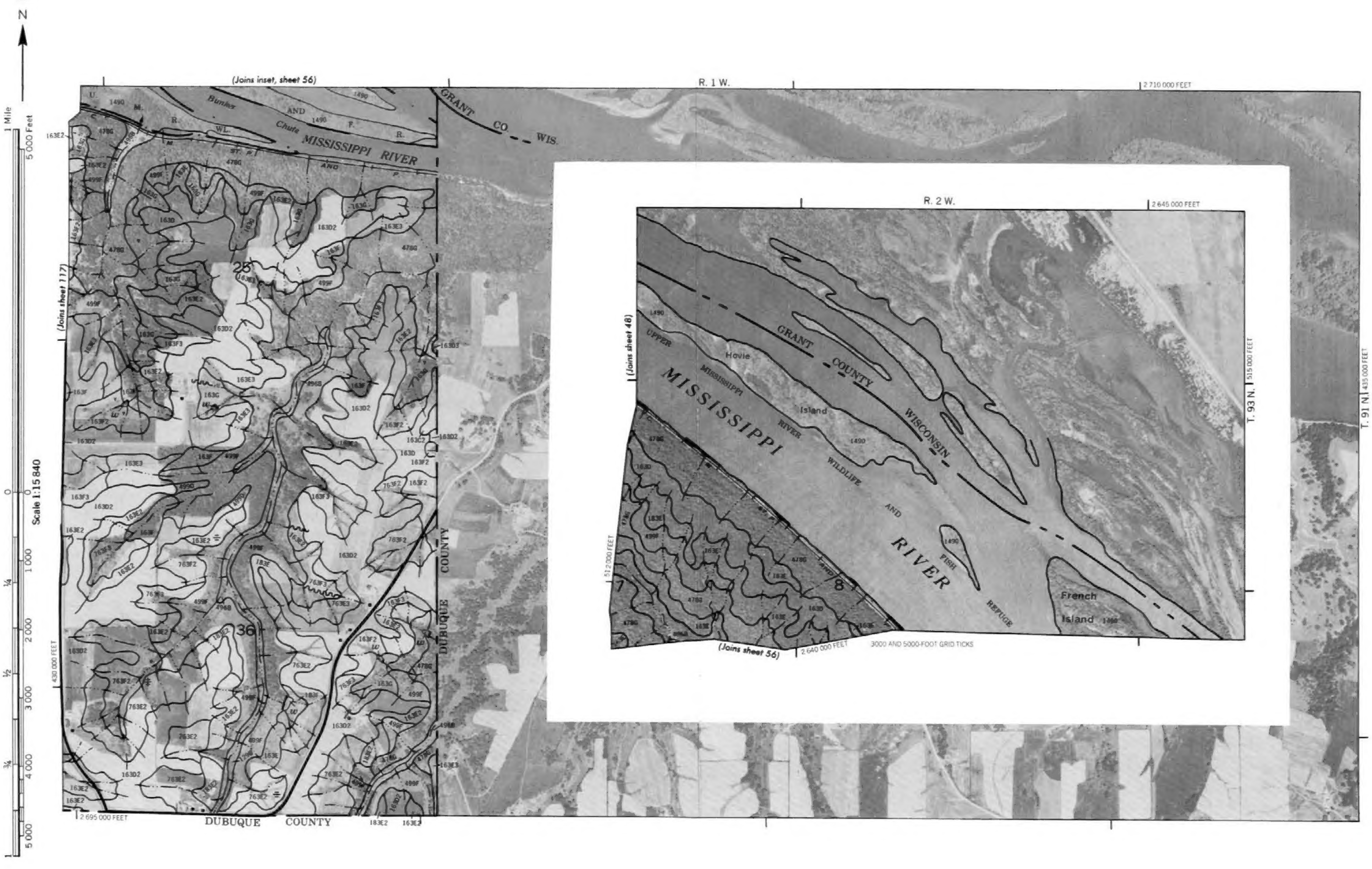

114
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 104)
(Joins sheet 113)
(Joins sheet 115)
R. 3 W. | R. 2 W.
T. 91 N.
27
26
25
30
34
35
36
31
Turkey
Little
DELAWARE COUNTY
DUBUQUE COUNTY


N
R. 2 W.
(Joins sheet 105)
(Joins sheet 116)
(Joins sheet 114)
T. 91 N.
2 640 000 FEET
435 000 FEET
430 000 FEET
2 655 000 FEET
DUBUQUE COUNTY
30
29
28
27
31
32
33
34
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾

CLAYTON COUNTY, IOWA — SHEET NUMBER 116




N
R. 1 W.
T. 91 N.
(Joins sheet 107)
(Joins sheet 116)
(Joins sheet 118)
DUBUQUE COUNTY
2 680 000 FEET
2 690 000 FEET
435 000 FEET
430 000 FEET
Panther
Hollow
Plum
Creek
28
27
26
29
32
33
34
35
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
(Joins inset, sheet 56)
(Joins sheet 117)
MISSISSIPPI RIVER
Bunker Chute
U. M. R. WL. AND F. R.
GRANT CO. WIS.
R. 1 W.
2 710 000 FEET
25
36
DUBUQUE COUNTY
DUBUQUE COUNTY
2 695 000 FEET
430 000 FEET
T. 91 N.
435 000 FEET
R. 2 W.
2 645 000 FEET
(Joins sheet 48)
MISSISSIPPI RIVER
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
GRANT COUNTY WISCONSIN
Hovie Island
French Island
T. 93 N.
515 000 FEET
512 000 FEET
7
8
(Joins sheet 56)
2 640 000 FEET
3000 AND 5000-FOOT GRID TICKS